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Occupation of the Chair of the South African District with which is combined a vice-presidency of the parent Institution, is a special privilege, because it is conferred upon a member, by his colleagues, possibly once in a lifetime. I am most grateful for this honour, bestowed by friends, united within the common bonds of a beloved profession. I wish also to acknowledge my indebtedness to the Town Council of Springs, where it has been my honour to serve for the past twenty years and to thank the City Council of Johannesburg for having permitted me to attend this conference.

A presidential address is peculiar in that there are apparently no restrictions whatever as to subject matter, mode of treatment, or length. One is at complete liberty to speak as the spirit moves one, with the reassuring knowledge that there will be neither discussion nor questions asked!

The addresses of my predecessors provide stimulating reading. They cover subjects as diverse as the Napoleonic wars and corrosion in sewers. Mine are the random thoughts, in personal vein, of a civil engineer and a South African, upon the privileges **and responsibilities** of his profession and the destiny of his country, against the background of the mid-20th Century, in the vast setting of the African continent from which some new thing is always emerging.

1953 has, in a very special sense, been a year of grace. With
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the Coronation and dedication of our Sovereign Lady, Queen Elizabeth, it has seen the inauguration of the New Elizabethan Era. (Councillor delegates will be interested to know that a loyal address from the 7,000 members of this Institution was presented to the Queen, in connection with the Coronation and that the Duke of Edinburgh is an Honorary Member of the Institution).

1953 has seen the conquest, by the intrepidity of the human spirit, aided by modern science, of Mount Everest, a feat made possible by unity and splendid teamwork between peoples of East and of West, of different colours, creeds and cultures, without which the world's highest peak would forever have remained inviolable: that the final assault was made by a white man and a brown man, roped together is, to my mind, of tremendous significance for the future of the world.

Lastly, it is fitting that our conference, although not coinciding with the actual celebrations in Bulawayo, should be taking place in Southern Rhodesia, 100 years after the birth of its founder and in the first year of its federation with Northern Rhodesia and Nyasaland.

Cecil John Rhodes died at the age of 49. I wonder what this extraordinary man, in whom the materialist and the visionary were so strangely combined, would not have achieved had it been granted him to live the allotted span, another 21 years.

Ever impatient of delay, it was he who instructed the great contractor, **George Pauling**, to complete 300 miles of railway line in 300 days, a feat duly accomplished within the specified time, thus setting a world record. And, as is commonly known, it was Rhodes who was responsible for the wide streets which are a feature of Rhodesian towns.

His realistic approach to the 'Native problem' is revealed in a speech* to the Cape Parliament in 1887:-

/"We

" We have to govern the Natives as a subject race. Treat the Natives as a subject people as long as they continue in a state of barbarism and communal tenure; be the lords over them The Native is to be treated as a child and denied the franchise; he is to be denied liquor also When they turn out men who are capable of administering the telegraph and postal system and of doing carpentering and managing machinery, these are the men who will get the franchise without difficulty"

This has relevance to a theme which I shall develop later.

Rhodes the visionary and arch-planner is best revealed in a speech**, at a banquet, given in his honour, by the citizens of Cape Town:-

" I remember, in the impetuosity of my youth, I was talking to a man advanced in years, who was planting - what do you think he was planting? He was planting oak trees. And I said to him, very gently, that the planting of oak trees, by a man advanced in years, seemed to me rather imaginative: He seized the point at once and said to me, 'You feel that I shall never enjoy the shade? I know but with me rests the conception and the shade and the glory!'"

It was this remarkable capacity of looking into the future that enabled Rhodes to visualize, not bare veld, but a majestic avenue of oaks - where ordinary mortals would see a handful of acorns, mere pig food - that distinguished Rhodes from other men. After his death, amongst his papers was found in his writing:-

" If there is a God and He cares for men, then the most important thing in the world for me, is to find out what He wants and then go and do it."

Perhaps the man who cried "Homes, more homes!" for his settlers, was not so much the materialist after all.

Thrice blessed is he who finds his occupation congenial and rejoices in his work. I am most thankful for pleasant paths traversed and good companions encountered, in the course of my work. What is it that makes the practice of our profession so completely satisfying and worthwhile? Why should "the art of directing the great sources of power in nature for the use and convenience of man" prove so romantic and exciting? Why does the mere thought of our work fill me with exultation, so that I would exchange it for no other?

The definition of our activities sounds prosaic: yet there is none better. Bear with me while we analyse it: "art" implies the exercise of ingenuity and skill; "directing" denotes activity

/and fulfilment

** Vindex - Page 359.
+ Thomas Tredgold, 1788.

fulfilment as against the agony of inactivity and frustration; "power in nature" signifies the taming and harnessing of the universal elements of air and water, and fire and earth; "use and convenience" indicates the rendering of a useful service. So we have the profession summed up as a skilful and pleasant activity, resulting in service to mankind.

We deal with things clean and elemental, wholesome and earthy, which seem to satisfy a primitive creative instinct, deeply embedded in our natures - as satisfying to us as the making of mud pies or sand castles is to children. We are concerned with the infinite variations on an old, old theme, as old as the hills: a theme of change, of a vast and dimly comprehended cycle of decay and growth of destruction and construction, of death and resurrection. We may perhaps call it the principle of the "indestructibility of matter" or of "conservation of energy": something which we cannot prove but instinctively know to be true. In the long run nothing is lost: mountains and land masses are weathered and broken down but new continents are being created on the ocean bed and will be raised up in a million years; timber decays but organic matter again enters the soil to assist in the growth of the new forest; drops of rain are absorbed by the thirsty earth, to reappear years later as a spring at a distant point; the veld grass is burnt and even if the veld is ruined the products of combustion remain. In the long run nothing is lost. Often our work is to retard or to accelerate the natural cycle.

Consider these elements - the raw materials of our craft: Water in all her forms and moods - as ice, hard and sharp and cold, prodigiously powerful, though static; impounded, stagnant, silent, sullen; flowing, silently useful; in flood or storm, roaring turbulently destructive; floating as light misty vapour; precipitated as gentle snow or suddenly as vicious hail; domestically dutiful in a kettle or measurelessly mighty, superheated in a steam turbine:

"It streams from the hills, it descends to the plain,
And sweetly distils in the dew and the rain".

With St. Francis, who studied no hydraulics, knew no cusecs and possibly never heard of Archimedes' principle, but loved nature, we may joyfully sing:

"Be praised, my Lord, for Sister Water, sure
None is so useful, lowly, chaste and pure".

Through the ages man has been vitally concerned with earthworks of one form or another, whether burial mounds, such as the ancient pyramids or barrows, or fortifications - notably the great walls or smaller local defensive works. But the period of maximum excavation coincided with the industrial revolution. The construction of railways, roads and canals created more scars on the surface of the earth than the sum total for all previous years in the world's history. Earth in all its forms and rocks of every description, sedimentary and igneous, have been cut and filled, compacted and levelled, rolled and scarified, trenched and furrowed, quarried and tunnelled to an unprecedented extent. In place of spade and barrow we have mammoth earthmoving equipment, excavators and tractors which make the prodigious manual efforts of de Lesseps appear puny.

Reference must be made, in passing, to those important materials, derivatives all, of Mother Earth, which the engineer finds indispensable in the pursuit of his craft. I refer to coal which raises steam from water; burns bricks and tiles and pipes from clay and lime and cement from other earths; and smelts steel and copper from their respective ores.

Again may we sing with the simple saint who knew nought of thermo-dynamics or soil mechanics, the praises of Brothers Wind and Air and Fire and of Sister Earth, our Mother.

So much for nature quiescent; what of nature rampant?

As our President reminded us: "We are accustomed to consider that we have the command of nature in our hands but we are often rudely awakened by her fury and power which in a matter of minutes exceeds man's worst horrors". He was referring to the floods in Britain and Holland. Now we have earthquakes in the Ionian Islands and vivid in our memories are the Transvaal tornadoes. Of these

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phenomena the engineer is no disinterested spectator. Behind his every undertaking are the ever present factors (often, but not invariably conflicting) of cost and risk. Cost in lives and in money and risk of failure. To spend money needlessly so that a structure is excessively strong is bad engineering; to erect a dangerous structure in order to save money is criminal. The art of the engineer is to assess the incalculable, to accept justifiable risks in the light of past experience, present conditions and possible future developments. The correct solution, in some cases, will be to accept periodical failure. The engineer exercises his judgment in determining the factor of safety, sometimes cynically but realistically called the 'factor of ignorance'.

Mr. A.P. Laing said in 1949: "Every engineer leaves a lasting impression of his qualities on the town he serves". Almost certainly no other profession or class of individuals as a whole, is entrusted with the expenditure of public funds, whether in peace or war, to the extent of the civil engineer. If he discharges his duties indifferently the cost to the public may be considerable and continuing. An error in judgment may do incalculable harm. He is constantly called upon to exercise ingenuity and initiative in facing new and unexpected situations. Above all, his professional honour and integrity must be beyond question. Opportunities for dishonest practices frequently present themselves. The engineer is constantly subjected to temptation. It therefore gives me great satisfaction to state that I have never heard of a case of a municipal engineer misappropriating public funds. Most treasurers accept a certificate signed by the engineer without question. May it ever be so.

Direction of natural forces automatically signifies the acceptance of risks. It is the very stuff of romance. To fit oneself, equipped with sliderule and theodolite as well as the confidence and resilience of youth, against Hill Difficulty, narrowly avoiding disaster in the Slough of Despond, in order to load sparkling waters from the Delectable Mountains, through the Valley of Endeavour, at last to the City Beautiful, is high adventure indeed.

The thrill of plotting that first tacheometer survey, as the ground took shape under the contours (do you remember searching for an
/obliging

obliging spider to provide a collimation hair for that old-fashioned instrument?); the undiluted pleasure of seeing that first simple design transferred, step by step, from the drawing board into the realms of concrete reality - sturdy and not bad looking, one modestly admitted, with the emotions of a father contemplating his firstborn; overwhelming relief at the filling of a dangerous excavation; **realisation** of worthwhile work well done - of coming out within the estimate despite adverse conditions; mistakes made and lessons learned; enduring satisfaction at the sight of happy, shining faces of former slum dwellers now occupying their own dwellings; the existence of a thousand homes where yesteryear was veld - these are the threads woven into the tapestry of achievement, the product of our craft.

Difficulties do arise when our professional loyalties appear to be in conflict with our loyalty to the authority we serve. It is my earnest conviction that our service consists mainly in giving responsible technical advice and guidance to our Councils and not merely in carrying out what may have been decided. We must give a lead to councillors so that they may formulate sound policies. An engineer cannot allow a decision to be taken, contrary to what he considers to be the best interests of the public, without firmly and clearly presenting his views and insisting upon his opinion being recorded. As a Council gains confidence in its engineer, it will seldom depart from his advice in matters of any moment.

Most small towns must have passed through the stage when it is hotly debated whether to go ahead with a Sewerage Scheme or build a new Town Hall. The Town Hall generally wins. But the engineer must, of course, do his utmost to support the M.O.H. in so clear cut an issue. Another distressingly common example of misguided action by Councils occurs at the annual "pruning of estimates" when it is invariably suggested that items such as "maintenance and re-sealing of roads" should be reduced or deleted. It behoves the engineer firmly to resist and to point out the folly of reducing

maintenance votes.

For the benefit of our younger colleagues let it be repeated: loyalty to professional principles - which transcend all other considerations, **even ward boundaries** - comes first. The criterion is not WHO is right but WHAT is right. But make quite sure that it is not prejudice on your side!

We are vitally concerned with human relationships. As we grow older and occupy more senior positions we realise more and more that our job is largely that of handling men **aright** so that they in turn will handle materials correctly. One learns to profit by the experience of others, to have an open mind, not to be dogmatic and to admit having erred; to give praise where it is due; to delegate authority, not to dominate but to integrate the activities of a team; that contrary to general belief human nature can and does change; even to apologise to the lowliest member of the staff, if this be his due, for "sorry is a magic little word" and if sincerely given produces an immediate reaction of goodwill.

Hardy Cross* in his interesting book sums it up well:-

" It is important that men know that engineers do not build alone with concrete and steel, or by formulas and charts, but more than anything else by faith, hope and charity - faith in their methods, their training, in the men with whom they work, faith in humanity, in the worthwhileness of life; hope that by use of these they may find men, money, materials and methods, not blind wishes but judicious hopes; charity that involves a sympathetic understanding of the human element and willingness to work within the limitations imposed by human weakness."

The pernicious suggestion is sometimes made that all that a man requires to become a successful engineer and to acquire prodigious knowledge, is to ~~buy~~ *purchase* for a trivial sum (in fact the first volume will be sent free of charge) what is known as a comprehensive library of "KNOW-HOW". Perish the thought and the ghastly hyphenation!

It is typical of our profession that we are so busy practicing our arts, our noses are so close to the grindstone, we are so absorbed in what we are doing (for idle engineers do not exist)

/that

* "Engineers and Ivory Towers!"

that we often fail to notice in which direction we are travelling. It is important that we should know what we are doing and why. I am reminded of the story of the three masons working in a cathedral. The first, asked what he was doing, said "I am working overtime". The second replied "I am trimming this stone". The third one cried "I am helping to build this cathedral to the glory of God". Motives are so terribly important. It makes all the difference in the world to be aware of a higher purpose.

As someone who has made a study of the genus has truly said - "Engineers tend to forget that they are not always looking through a theodolite". Pause a moment from that lifelong habit of peering through the telescope with its inverted image which you have come to accept as normal. There is really no good reason why everything should permanently remain upside down. If we give our minds to it, maybe some of these things could be set right.

As an old takhaar who insisted upon having a look through my instrument, when I was levelling in a Free State dorp, many years ago, ejaculated in amazement: "Magtig - die hele wêreld is onderstebo!" And it is so: the auguries are far from favourable. Apathy is the great danger. As a class, engineers are largely to blame. "We fail to perceive the dramatic greatness of our times. In the meantime, and it is this which lies at the root of our unhappiness, technical progress has outstripped the mind, matter has gone faster than spirit. It is so easy to become part of the forces of destruction, of domination and of violence. What is required is not to dominate but to serve - to preserve among men confidence in goodwill, in the spirit of co-operation, in justice, in goodness, in pity for the weak and outcast, in human dignity and in the power of truth".

At this stage we may well consider our position in this continent. In first year Mechanics we learned that inertia is the tendency to remain at rest - a tendency that has been maintained in

Africa, comparatively speaking, for hundreds of years. This tendency to remain at rest applies equally to men as to things: it is a state of mind (typically African) - as well as a state of motion. The difference between the present and all previous ages, is that Africa is now awakening, like some gigantic Rip van Winkel, still sleepy but refreshed after her long rest; and she is awakening spiritually and materially at a rate which is frightening if it cannot be controlled. External forces have abolished inertia. Uncontrolled acceleration is dangerous; properly directed it can be useful.

This is the new thing that the travail of a continent has brought forth. And unless we are so foolish as to deny that South Africa is inescapably an integral part of the whole continent, the control of this great source of human energy is a job in which we, as a profession, are bound to participate.

We have hitherto regarded Africa as a vast reservoir of unskilled labour. From the primitive uncivilised millions there is emerging, as a result of education, and especially in the urban areas, a class of semi-skilled, skilled and even professional men. With the advent of the Industrial Revolution into Southern Africa, thousands of Africans have revealed themselves as particularly well adapted to repetitive work and they are increasingly employed as operatives in newly established factories. Furthermore, it has been established beyond argument, in many parts of the country, that properly supervised and in spite of limited opportunities and indifferent training, the African builder - whether bricklayer, carpenter, plumber or painter, can build simple cottages cheaply and well. The Native Building Workers Act of 1951 was a great step forward. It is just a matter of time before all technical operations within the confines of declared "native areas" will be carried out exclusively by Africans. This will gradually result in the growth amongst African communities of a "middle class".

It is heartening to find the development of Africans in this

manner being supported by so eminent a figure as the Administrator of the Orange Free State, Mr. J.J. Fouche, who said:-

" It is our holy duty to encourage Bantu nationalism and to help it develop.

The Europeans wanted the Non-Europeans to become completely civilised and self-sufficient because: first, the Europeans were Christians; secondly, the country would never be developed fully while the majority of the population remained in a semi-civilised state; and thirdly, the Europeans would find it increasingly difficult to pay for the service required by the Non-Europeans.

A great deal of frustration had arisen from the fact that Natives were educated without being given the opportunities to make use of that education. Today the Union was on the eve of a new development. The education given to the Bantu would go hand in hand with opportunities for earning more money. He would be used more productively in the interests of the community, but especially of his own race."

Africans have been trained as teachers in large numbers with a mere sprinkling of medical and legal practitioners. Facilities for medical training are now being extended and for a number of years Africans have been trained as Health Inspectors, Welfare Workers, etc., forming what might be regarded as the nucleus of a professional class. The fact is that the resources of the white population, in a young and developing country, are hopelessly inadequate to attempt to provide sufficient professional men to administer the entire population.

Our own profession has no less important contributions to make to the life of the community than those mentioned. As a result of a most thorough investigation of the position, the South African Institution of Civil Engineers has ascertained that there exists a shortage of at least 20% (more than 400) in the complement of civil engineers alone. Making use of every possible training avenue, i.e. indentureship as well as the universities, the output cannot be increased. This, according to the report "compels a reorientation of our approach to engineering services".

We must work with and no longer for the African: to build a new dimension of racial unity between African and European by accepting the moral responsibility that rests so largely on members

of our profession. It behoves us, who are engaged on large scale works in Native areas to consider whether we are employing to the fullest possible extent, Africans in skilled and semi-skilled capacities. The European manpower position is such that their employment in Non-European areas is to the detriment of the country as a whole. It is undeniably for us, as municipal engineers, to give a lead in the matter of producing African tradesmen in sufficient numbers for the tasks that lie ahead.

I am reminded of our predecessor, the great Thomas Telford (1757-1834) and the situation in which he found himself, at the beginning of the Industrial Revolution in Britain, some 150 years ago. (If I may be permitted to digress for a moment - it is of interest to note that Telford, the journeyman mason who earned 18 pence a day, when he became the most eminent engineer of his time, in charge of tremendous projects throughout the country, received £500 per year out of which he paid a clerk, a foreman, and all his travelling expenses!) But the point I wish to make is that Telford was faced with having to train his own labour force. To quote him -

" These undertakings I regarded in the light of a working academy, from which 800 men have annually gone forth improved workmen. 3,200 men were annually employed (on the Caledonian Canal) and taught for the first time the use of tools."

From uncouth and illiterate Highlanders he created a force of skilled tradesmen. We stand very much in the same relationship to the African at the present day. Indeed, it has been demonstrated repeatedly that the best form of training for bricklayers, is on a large housing scheme. This is the answer to the argument that Native building workers are not in sufficient numbers to tackle really large scale projects. There is nothing so demoralising as inactivity. I have said before and I say again that there is no reason, other than finance, why Johannesburg should not build 5,000 houses a year or 20 houses per working day employing, exclusively, Native building workers, the majority of whom would be learners. Britain is building at the rate of 1,000 houses every day.

Where there is a will there is a way. Telford, faced with an unprecedented volume of public works, including canals, bridges and harbours, throughout the British Isles, "devised the system of carrying out public works by contract and caused a body of contractors to grow up, who raised their standards of skill and honesty. He started the system of retention money and monthly payments"* What a superb example of initiative and improvisation!

How can we, with all the advantages of modern mechanical equipment and a vast reservoir of potentially skilled workers possibly subscribe to the suggestion that the building of 350,000 Native houses in 10 years, is beyond our capacity? Mr. Jennings, Director of the Building Research Institute, states that this is probably the biggest civil engineering task in the country. Remember that Telford had neither concrete mixer nor Portland cement.

As regards technical personnel - field assistants, draughtsmen and engineering aides, upon whom the routine duties devolve in other parts of Africa, it would seem to me that the time has arrived for the South African District of the Institution to set up a committee to investigate and report upon the training of selected African personnel for employment exclusively in Native areas, as defined by the Native Building Workers Act. The Technical Colleges would, I am sure, arrange classes in the required subjects. Action taken now, by the Institution, on broad and generous lines, will be to the economic advantage of the country as well as promoting inter-racial goodwill. The initiative rests with us.

There is a strange similarity between the sentiments of the late J.H. Hofmeyr and those of Mr. Fouche already quoted.

" There is no future for this as a Christian nation save on the basis of a generous respect for the dignity of all men, and unwavering activity towards the removal of inequalities of opportunity, and in open-hearted readiness to concede to others what we regard the Fatherhood of God as meaning to ourselves."

/Hard-headed

* J.H.H. Wilkes - "The Municipal Engineer in Modern Life".

Hard-headed engineers will often be persuaded by nothing less than the irresistible logic of figures. The white population of Africa is less than 4-millions; the non-white population is little short of 200-millions. In view of this vast disparity, what are the conditions necessary for the continued existence on this continent of the white minority? The issue seems to me quite plain: it is all a question of motives. If our motive, outward or concealed, is exploitation or domination, then our stay is short indeed: to be compared with the Roman attempt to colonize the Northern extremity of Africa which failed 1,500 years ago, leaving in its wake the devastation of an eroded wilderness: we shall be driven into the sea. If our motives are right, if we remain for the good of our country, in order to give and not to take, our retention in the country will be eagerly desired. We shall remain here only on the basis of being wanted; only if we are asked to stay. As a profession we have much to give; as individuals we can help a great deal to develop goodwill.

In conclusion, may I be permitted to deal very briefly with three matters: the preservation of our peoples, of our soil and of our atmosphere - which add up to the preservation of our country.

The employment of Africans to build houses will do much to reduce the ravages of T.B. - the scourge which kills, in sunny South Africa, 55 people every day - by increasing wages and relieving overcrowding. As for the soil, its rapid denudation is contributory to human erosion. Let us admit to our shame, that in the early days, by concentrating runoffs through railway culverts, and elsewhere, we created conditions favourable to erosion. I do wish that as much were spent in the Union on conservation measures as on new road construction; the former is absolutely vital; the latter a luxury. I must confess also to very grave misgivings concerning the imminent erosion of the vast slimes dams on the Witwatersrand. As a Reef-dweller, I regard these man-made, stratified mountains with apprehension, while

mines are producing, the slimes is constantly watched and maintained, breaches being repaired and new walls being built. But once the mine closes down, millions and millions of tons of the most easily erodible material on earth will, sooner than later, find its way into the streams, fouling the watercourses and doing irreparable damage by covering many square miles of rich alluvial soil with inert silt. A rough calculation gives more than 200 million cubic yards of slimes for the Springs area alone. Multiply this for the whole Witwatersrand and look ahead to the year 2,000! The solution may lie in one or more of the following: stabilisation; disposal underground or the containing of the slimes by building huge rock walls across the valleys. The cost in any case would be stupendous. My feeling is that the damage has been done, and I wish to make it quite clear that I do not blame the mining engineers. Maybe this can be avoided in the Free State.

Lastly, the question of preserving the purity of our atmosphere. Aerial pollution marches hand in hand with industrial development, especially when this development is based on the utilisation of cheap low-grade coals. Here the answer is a simple one: education in the use of clean, smokeless modern fuels such as gas and coke, hygienic and economical. Strangely enough in the production of sulphuric acid the domestic grate remains the worst offender. Anyone who has visited a large Native location at dusk in winter has seen the pall of smoke that rises from the thousands of stoves and braziers, certainly the most wasteful and dangerous of all heating appliances.

I quote figures from Mr. Paton Watson's address -

"The deaths in the London area in one week of these fogs rose from 1,852 to 4,703. Prize dairy cows on their way to a show in London died of suffocation."

What better objective can we have as a nation than the maintenance of peace and goodwill amongst our varied peoples, the safeguarding of their health by conserving our soil for the production of wholesome

/food

food and the preservation of a pure atmosphere for all to breathe? 'Tis a consummation devoutly to be desired and it is dependent on racial unity - a new dimension of racial unity based on new moral standards of the nation.

Finally, a thought from Thomas a Kempis, applicable to councillors and those set in authority over us, no less than to ourselves:-

"He doeth much that loveth much.
He doeth much that doeth a thing well.
He doeth well that serveth the community
rather than his own will."

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