A university and an industry — the relationships between Wits and the South African metallurgical industry

Presidential Address

by R. P. KING*

SYNOPSIS

The University of the Witwatersrand (Wits) and the minerals industry of South Africa have grown with the city of Johannesburg. The former has provided teaching and research in mining and metallurgy, while the latter has been responsible for the practical training of metallurgists and for the testing and implementation of innovative ideas proposed by the academics.

This interplay between inventiveness and industrial application is illustrated by three examples: the establishment of the iron and steel industry as a result of the persistent experimentation undertaken by Professor G. H. Stanley, the first Professor of Metallurgy and Assaying at the South African School of Mines, which later became Wits; the establishment of the research organization that eventually became the Council for Mineral Technology (Mintek) — again through Professor Stanley's faith in the role of research; and the establishment at Wits of physical metallurgy as a discipline in its own right, as first suggested by Professor C. E. Mavrocordatos of Wits against the opinion of his colleagues in the industry.

The Department of Metallurgy at Wits has been well supported by the minerals industry. Not only does the industry provide grants for the financial support of students, but it supplements the salaries of personnel in the Department, making possible the recruitment of top-class academic staff.

At present the greatest problem is the lack of interest shown by matriculants in the metallurgical industry as a career. However, an enormous effort is being made by the Chamber of Mines, The South African Institute of Mining and Metallurgy, and the Wits Department of Metallurgy to ensure that matriculants receive appropriate information about the career prospects in the minerals industry.

SAMEVATTING

Die Universiteit van die Witwatersrand (Wits) en die mineraalbedryf van Suid-Afrika het saam met die stad Johannesburg gegroei. Eersgenoemde het onderrig en navorsing in mynbou en metallurgie verskaf, terwyl laasgenoemde verantwoordelik was vir die praktiese opleiding van metallurge en die toets en toepassing van nuwe idees wat deur die akademici voorgestel is.

Hierdie wisselwerking tussen vindingrykheid en industriële toepassing word deur drie voorbeelde geïllustreer: die vestiging van die yster- en staalbedryf as gevolg van die volhardende eksperimentering deur professor G. H. Stanley, die eerste Professor in Metallurgie en Essaiëring aan die South African School of Mines wat later Wits geword het; die daarstelling van die navorsingsorganisasie wat uiteindelik die Raad vir Mineraaltegnologie (Mintek) geword het — weer eens as gevolg van professor Stanley se vertroue in die rol van navorsing; en die invoering van fisiese metallurgie as 'n selfstandige dissipline aan Wits soos vir die eerste maal deur professor C. E. Mavrocordatos van Wits aan die hand gedoen is, ten spyte van teenkanting deur sy kollegas in die industrie.

Die Departement Metallurgie aan Wits is goed deur die mineraalbedryf ondersteun. Die industrie maak nie alleen toekennings vir finansiële steun vir studente nie, maar vul ook die salarisse van die personeellede van die Departement aan sodat puik akademiese personeel gewerf kan word.

Op die oomblik is die grootste probleem die gebrek aan belangstelling in die metallurgiese bedryf as loopbaan by matrikulante. Die Kamer van Mynwese, Die Suid-Afrikaanse Instituut vir Mynbou en Metallurgie en Wits se Departement van Metallurgie wend egter 'n reusepoging aan om te verseker dat matrikulante toepaslike inligting oor die loopbaanvooruitsigte in die mineraalbedryf ontvang.

Introduction

The City of Johannesburg and its university, the University of the Witwatersrand (Wits), have grown to maturity and developed with the industry that spawned them. The mining industry has exerted many influences on the city and the university, and from its earliest beginnings the university sought to provide educational facilities that would enable its graduates to benefit from the career opportunities offered by the local mining industry. Over the years, the mining industry has maintained a strong link with Wits. The university has always provided professional education in mining and metallurgy, and the industry has provided financial support in specialized areas of educational and research activity that meet the specific needs of the industry as well as supporting the broader educational process. Today Wits has departments of metallurgy and mining engineering that have international reputations, and that provide many of the graduates who make technical careers in the South African mining and minerals industry. It is my intention to examine some of the more interesting aspects of the relationship between the university and the industry, and in particular to assess whether this close relationship has produced results that both sides would

* Chamber of Mines' Professor of Extractive Metallurgical Engineering and Head of the Department of Metallurgy, University of the Witwatersrand, Jan Smuts Avenue, Johannesburg 2001.

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regard as satisfactory.

The relationship has not always been straightforward. Often there have been periods when the university has seemed to be out of touch with the immediate problems of the industry, which has expressed concern in a variety of forms from time to time. However, the record shows that the industry has been well served by the university that it helped to create, and today the many strong and direct links between the two are among the best examples anywhere of the benefits to be gained by meaningful collaboration between university and industry.

Innovative Ideas and the Academic Ideal

The university inevitably attracts academics who have a strong tendency towards innovative and analytical ideas and, to a certain extent, do not want to burden the educational process with the teaching of practical process operations. Provided that the graduate is adequately prepared to develop his understanding by logic and by reason based on fundamental scientific principles, his practical training can be safely left to his first few years in industry. Non-academics do not always see education in that light, and from the very earliest days the debate between the 'educators' and the 'trainers' has persisted. In one of the earliest public appeals for the establishment of a school of mines in Johannesburg (1897), Mr John Daniells made a strong plea for a completely practical training and he proposed that 'the less we have to do with pure academicism the better'[1]. He was soon taken to task by Professor J. G. Lawn, the first professor of mining engineering in South Africa, who visited Johannesburg from the Kimberley School of Mines in 1898 and argued that high academic standards would be the only way to attract the best young men into the proposed school of mines[2]. The debate on the relative merits of a technical training as opposed to an academic education will continue, but I believe that Wits will continue to follow a pragmatic approach to the education of metallurgical engineers and will remain sensitive to the real and immediate needs of industry.

Training and teaching form but one aspect of education. Good education also needs research, and it is this aspect of education that essentially defines the relationship between industry and university. The metallurgical industry in South Africa has been dominated during the past century by a need to process mineralogical raw minerals, and from the very beginning the search for better processing routes has dominated the minds of those engaged in minerals research in this country. The academics have been as conscious of this need as have the technologists in industry, but it has always been clear that the university could not by itself provide the physical resources for research into process development. It has been the ideal of the academics that they should provide the innovative ideas that lead ultimately to the introduction of viable industrial processes, but the industry must undertake the practical testwork and implementation. In general, the universities should be involved with such developmental research only until the process is proved at bench-scale level – after that the industrial research and development machinery should continue the development. Although innovative thinking is not solely the prerogative of academics, it is a necessary component of any vital educational process. It is precisely this interplay between forward-looking inventiveness and industrial application that has characterized the most successful periods of interaction between the university and industry. I shall illustrate this by giving three examples.

The Establishment of the Iron and Steel Industry

The establishment of the iron and steel industry in South Africa is an interesting example of the way in which innovative research at a university can assist in major industrial development.

The history of the iron and steel industry in South Africa is well-documented by Richards[3]. However, the role played by the University of the Witwatersrand is not so well known. The known large reserves of iron ore in the Transvaal, and the growing need of the mines and railways for steel during the first decade of this century, led to several proposals for the formation of an iron and steel industry that would reprocess scrap and also smelt the native ores of the Transvaal. The refractoriness of the abundant titaniferous iron ore seemed to present a major technical obstacle. Recognizing this, Professor G. H. Stanley, the first Professor of Metallurgy and Assaying at the South African School of Mines, which later became the University of the Witwatersrand, embarked on an ambitious experimental programme to establish whether the ores could be smelted successfully. Such an experimental programme was beyond the capabilities of the School's experimental facilities, but with considerable ingenuity he started work in a blast furnace made from a steel drum. His early experiments were not successful. He then obtained better facilities in the workshops of the South African Railways in Pretoria. By 1910 he was able to report in a paper read to this Institute that the titaniferous ore could be smelted[4]. It is interesting that Sir Robert Kotze, the Government Mining Engineer, was fully sensitive to the importance of Stanley's experiments, and provided the necessary financial support for his fairly expensive piece of experimentation. Clearly, Stanley had taken his investigation as far as was possible with the resources at his disposal, but his vision of an indigenous iron and steel industry did not fade. In 1917 he designed a blast furnace for the Transvaal Blast Furnace Company Limited, which was erected and operated in Vereeniging[5]. In the same year, he prepared a comprehensive report on the commercial and technical feasibility of a local iron and steel industry[6]. However, it was only ten years later that Iscor was established (1928).

Although many people contributed to the eventual establishment of Iscor, the input from the university through the work of Professor Stanley was obviously very significant. His technical understanding of iron and steelmaking, together with his far-sighted assessment of the requirements of the local mining industry, made his contribution exceptionally valuable. It is significant tha the was among the very first to clearly perceive the nature and extent of the technical problems involved, and it must be recognized that it was his experimentation that proved that the titaniferous ores could be smelted.

The Establishment of MRL–GML–NIM–Mintek

A second example of strong interaction between the Department of Metallurgy at Wits and the local industry, with the university taking the innovative role, is provided by the establishment of the Minerals Research Laboratory. Again, Professor G. H. Stanley played a leading role in what was probably the most far-reaching decision regarding research in mineral sciences ever taken in South Africa. As early as 1914, in his Presidential Address to this Institute, Professor Stanley pointed out the need for research facilities in South Africa that could be made available for the investigation of technical problems generated in the minerals industry[7]. He was keenly aware that such facilities would have to be available for the investigation of fundamental questions that are not directed entirely towards immediate financial gain. He argued persuasively that better understanding of the fundamentals of mineral-processing operations would inevitably lead to great financial and other benefits to the community. Research on immediate practical problems would not be enough.

Professor Stanley's faith in the role that research must play in supporting the South African industry led him to make the departmental laboratories of the university available for research by interested parties, and he was successful in attracting funds from the State for equipping these laboratories.

The idea of a research organization to serve the needs of the minerals industry did not receive the support that it deserved, and Professor Stanley formally approached the Department of Mines in 1927 without success, and again in 1933. It was not until the latter approach (almost two decades after his first proposal) that his ideas bore fruit. A memorandum from Professor Stanley to Dr Hans Pirow, the Government Mining Engineer, was enthusiastically received by the latter and strongly supported .

Events moved quickly after that, and in 1934 the Mineral Research Laboratory (MRL) was established by the Department of Mines within the Department of Metallurgy at Wits, with the Professor of Metallurgy and Assaying as its part-time Director. This arrangement was immediately successful, and the provision of research scholarships to promising post-graduate students by the MRL from its inception ensured that a steady stream of research-trained technologists was available to the South African industry.

The success of the MRL is well known. It grew from strength to strength, and it gained prominence in the late 1940s with its pioneering research on the extraction of uranium from South African gold-bearing ores. It evolved into the Government Metallurgical Laboratory (GML), and then into the National Institute for Metallurgy (NIM), and now, as the Council for Mineral Technology (Mintek), it is recognized internationally as one of the best research establishments specializing in minerals-related research. The university is proud of its decisive role in the establishment of the MRL, and its subsequent relationship with its successors.

However, the years of close collaboration between the Department of Metallurgy at Wits and MRL–GML were to have an unfortunate effect that should have been foreseen but apparently was not. While the two organizations were physically together in premises provided by the university, the laboratory facilities were shared and the educational and research functions could proceed side by side. It was natural that the university department should not invest heavily in research equipment while the Laboratory was available to provide such facilities. When the MRL moved to its own premises across Yale Road in 1948, its equipment moved also but was still available for use by the academics because it was so close. However, when NIM moved to its present site in Randburg during the mid 1970s, the Department of Metallurgy was left in a parlous state, possessing virtually no research or effective teaching equipment and no longer having immediate access to the facilities at NIM. I have always thought that this was a poor reward to the university for its pioneering effort in nurturing and assisting the infant national research laboratory.

On the positive side, the relationship between the university and NIM was to give birth to a uniquely successful and innovative development in academic research. This was the establishment of the NIM research groups. It is unlikely that a research structure of this kind, which brings together a State research institute and an academic teaching department, exists elsewhere in the Western World. The research groups of NIM, and now of Mintek, operate on the basis of mutual and independent benefit to both parties. The research groups provide the university not only with the necessary funding to undertake research work but, perhaps more important, provide a focus for the direction of the academic research programmes. Some academics may regard this as an unnecessary limitation, but my experience has been that the enlightened attitude of Mintek has provided sufficient freedom for an academic to work comfortably. The benefits have been very great — certainly to the university and, I believe, to Mintek as well. The university has accomplished research that it would otherwise not have contemplated, and the supply of well-trained research manpower to Mintek has played an important role in the success that Mintek has undoubtedly achieved.

This relationship with Mintek has, in its turn, provided an indirect but very important link between the university and the industry, and this has been particularly true in the relationship between my department and the ferro-alloy producers in this country. Under the able leadership of Dr Jochens, the Pyrometallurgy Research Group pioneered a research activity that was not only very productive in its own right but was to lead to the development of a Pyrometallurgy Division at Mintek. In a sense this was history repeating itself: not only had the parent institute had its origin in the university department, but at least one of its constituent parts developed on exactly the same lines. I am optimistic that our future relationships with Mintek will remain at a level where important research programmes are initiated, perhaps at first on a very speculative level within the university department, and then mature and stand on their own as identifiable components of the overall research activity in South Africa.

The Development of Physical Metallurgy

My third example of innovation from the university concerns a very much more modern development and one that is still very much a current issue with our Institute. In 1960 Professor C. E. Mavrocordatos[9] argued that the traditional pattern for the education of metallurgists would have to change. At that time, the metallurgy curriculum at Wits gave something like equal weight to the three principal sub-branches of the discipline: ore-dressing, extractive metallurgy, and physical metallurgy. Graduates were capable of offering themselves professionally as extractive or physical metallurgists. Professor Mavrocordatos proposed that distinct curricula should be offered, but his suggestion found little favour with his industrial colleagues—the break with the traditional pattern seemed to them to be irrelevant and counter-productive—and the idea lay barren for a decade and a half. Events were to prove him correct, and the past two decades have seen a radical change in the curricula offered to undergraduates who wish to seek careers in the mining and metallurgical industries. The demands of the mining industry during the first half of the present century inevitably led to a curriculum in metallurgy that sought to produce a generalist as a graduate. The graduate was expected to, and did, turn his hand to the solution of a variety of problems associated with the beneficiation of minerals and the extraction and use of metals. The need for specialization was not perceived to be important by industrialists at the time. There appeared to be a real fear that specialization in any of the sub-branches of metallurgy would produce a graduate who had lost the broad scientific education that the university alone can provide. There was a belief that any specialist training should be provided by industry itself after graduation.

The views of the industrialists were well recognized by the academics, but the industrial view did not take cognizance of the tremendous surge in scientific knowledge that was flooding out in the post-war period. It was becoming very clear that the only solution to the educational dilemma lay in specialization. To ensure that an adequate component of pure science would be kept in the metallurgy curriculum, some of the applied science would have to go. This implied specialization, and the natural dichotomy in metallurgy between physical metallurgy on the one hand and extractive metallurgy on the other suggested that two identifiable curricula would not only be educationally desirable but would have many practical advantages for graduates when they entered the local metallurgical industry. The academic view eventually prevailed, and two separate curricula were introduced in 1976. These have met with the approval of both the extractive and the manufacturing branches of the industry.

Another development during the post-war years was also to have a profound effect on the education of metallurgists. This was the growth of chemical engineering as a scientific discipline. In South Africa this inevitably led to a situation in which chemical engineers took a greater and greater interest in the processing of minerals and the extraction of metals. The development of essentially chemical methods for the extraction of uranium with no beneficiation step (other than ore sorting) was a telling example of this trend. This was happening during a period of severe decline in academic interest in mineral processing during and after the war. As evidence of this, one could cite the appearance of Gaudin's book[10] in 1939 and the second edition of Taggart's[11] in 1945, which were to be the last ore-dressing textbooks of real quality to be published in nearly four decades. No major international scientific journal was published regularly dealing with mineral processing as a scientific discipline. For many years the proceedings of the International Mineral Processing Congresses, which appeared irregularly, were the only collected source of information on international research activities. National journals published by AIME in the U.S.A. and the IMM in the U.K. were parochial in their approach, and our own journal was no exception. It was not until the *International Journal of Mineral Processing* made its appearance during the 1970s that academic interest in mineral processing revived its international outlook. Meanwhile, such major chemical engineering journals as *Chemical Engineering Science* and *Industrial and Engineering Chemistry* in its new format rose to prominence and excited the imaginations of a whole generation of young engineers. The inward-looking preoccupation of the local industry with its own immediate problems did not help. Academic interest in mineral processing was kept alive at a handful of schools in the U.S.A., but the initiative was seized by chemical engineers who recognized that the discipline of process engineering included the processing of inorganic mineral resources just as much as the processing of organic and gaseous raw materials through chemical synthesis.

The South African metallurgical industry apparently welcomed this development, and was willing to employ chemical engineering graduates and provide the necessary training after graduation to make good the lack of specific knowledge concerning the properties and processing techniques applicable to mineral processing. The chemical engineering schools encouraged this trend, and claimed that the general and very fundamental curriculum provided for chemical engineers would make the graduate chemical engineer fit for a career in any branch of process engineering. That this was true is confirmed by the significant number of chemical engineers who have successfully entered the South African metallurgical industry, although my experience suggests that a disproportionate number of these have been concerned with research rather than production. Several chemical engineering departments in South African universities have formally incorporated mineral processing into their undergraduate curricula and into their research programmes. The Department of Chemical Engineering at the University of Natal was the leader, and established a NIM research group within the departmental structure in 1967. The University of Stellenbosch has offered an optional qualification in extractive metallurgy within the Department of Chemical Engineering for some years, and the Department of Chemical Engineering in the University of Cape Town includes mineral-processing topics in the undergraduate curriculum.

The strong interest shown by chemical engineers in mineral processing left the Department of Metallurgy at Wits without a well-defined role: it could not be identified with physical metallurgy, nor was it offering courses in mineral processing that were as attractive or as useful as those offered by the Department of Chemical Engineering. The recruitment of undergraduate students showed a steady decline in spite of a consistent upward trend in applicants for places in engineering as a whole. Clearly, some fairly radical changes were required and, after discussions between the industry and the university, distinct curricula in physical metallurgy and mineral processing were offered in the Department of Metallurgy for the first time, in 1976. This innovation has been successful. The research programme in pyrometallurgy, which had been the mainstay of research activity in the Department of Metallurgy for many years, was continued, and enabled the Department to maintain its links with the ferro-alloy industry. New research programmes in ore-dressing, particularly dealing with quantitative modelling and the control of unit operations, were established. Research in physical metallurgy increased dramatically, and is now by far the major contributor to the research effort in the Department. This research in physical metallurgy has attracted support from a new sector of the metallurgical industry—a sector that had previously shown comparatively little interest in the Department's work. This has added new impetus to the establishment and maintenance of a viable relationship with the local industry. Through a mutual desire to identify and solve real problems that are of immediate industrial interest, new vistas are unfolding and are surplanting our traditional pre-occupation with problems related only to the extractive-metallurgical industry.

However, the industry still labours under a post-war legacy of indifference to academic excellence. The industry has not demanded the highest level of academic skill from its graduates, and the more competent young men and a few women have gravitated naturally to chemical engineering, which appears to offer an intellectually broader and altogether more exciting vista. Even today, metallurgy loses the majority of the most competent matriculants to chemical engineering. The loss to the mining and metallurgical industry must be enormous, but, until the local industry can convincingly offer careers that provide graduates with the opportunities to use their intellectual skills to the full, this trend will continue. The local industry must re-appraise its attitude to the use of the latest techniques in engineering. It must be prepared to allow its young engineers to exploit modern automatic-control theory, mathematical methods, computer-aided engineering techniques, microprocessors, and the many other fundamental scientific and technological methods that can assist in mineral processing. Mineral-processing operations are very complex, and the often-heard dictum 'Keep it simple' exhibits a naiveté that is difficult to understand in 1983. Fortunately, many competent chemical engineers have recognized the potential for high intellectual activity offered in the mineral-processing field, and eventually make their careers in the mining industry or its related service industries. Much of the credit for this must go to the research organizations, which have stimulated research across a broad front in mineral processing. Mintek and its predecessor, NIM, must be singled out in this regard, but the mining industry in general must re-evaluate its attitude to its graduates and demand that they use and exercise their intellectual skills to the full.

The move towards the establishment of physical metallurgy as a discipline in its own right seems destined to continue. The necessary industrial interest is clearly manifest, the university has considered the possibility of creating a separate Department of Physical Metallurgy and Material Science, and further attempts to artificially shackle mineral processing to physical metallurgy must be doomed to failure.

The Present Position

The Department of Metallurgy at Wits has maintained a slow growth, and the academic staff have continued to take a very real interest in the needs and problems that are generated in the local metallurgical industry. It has sometimes been claimed that the structure and nature of the degree courses offered in metallurgy are too heavily biased in favour of industrial applications, and that they emphasize too narrowly the techniques and interests of a particular industry. There is some truth in this. It is our conscious policy to produce a graduate who can relate his education directly to the situation he encounters in industry during the early part of his career. While this approach has the support of the industry, it is not certain that it results in the greatest possible supply of graduates to the mining industry. Many young people view our degree course as too narrow, and many, unfortunately often the more capable, elect to take degrees in other branches of engineering because they perceive that more career options are open to graduates in mechanical or chemical engineering. But we seem to be doing what industry wants. Many of the conversations that I have had with colleagues in industry make me believe that the university should not make any substantial change in the metallurgy curriculum — at least not in the foreseeable future.

The academic staff in the Department of Metallurgy at Wits all have a considerable commitment to pursue their academic careers in close contact with their industrial colleagues. Their teaching activities reflect to a large extent their interest and experience of industrial problems. As far as it has been possible, staff have been selected to bring a balance of academic and industrial backgrounds into the Department. This is demonstrated in the research programmes as well as in the undergraduate curriculum. Today there are 35 post-graduate students registered for higher degrees in the Department. Most of these are supported financially by grants from specific industries while they are undertaking their higher-degree research. Only a very small proportion of our higher-degree students are financed in the traditional way by bursaries from the State and the University itself. The Department has always attracted sponsored research work from industry, and today almost half of the staff in the Department are financed by sponsored research programmes.

It is not only in research that the minerals industry has supported academic activities. The industry has, through the Chamber of Mines, supported academic staff salaries by supplementation for many years. This has made a significant difference to our recruiting potential for top-class academic staff. In recent years, Iscor has provided the same support for salaries of physical metallurgists in the Department. It has been my policy to appoint to the staff only academics of the greatest competence. I have preferred to keep posts vacant rather than fill them with mediocre people. This has meant overloading of the academic staff, but the price has been worth paying. The Department is at present fully staffed for the first time in many years, and the recent revisions of the curriculum have produced curricula in minerals process engineering and physical metallurgy that we believe are appropriate to the requirements that industry will place on our graduates. At the same time, these curricula provide the academic staff with the scope that they require to make modern theoretical and practical presentation in their areas of speciality.

Perhaps the most worrying aspect of the relationship between Wits and the mining industry at the present time is that industrialists doubt the value of post-graduate work and the industry appears to have very little place for the Ph.D. graduate. Most mining companies recruit metallurgists after a first degree and do not encourage them to stay on at university for post-graduate work. Students who may consider staying on are advised that industrial experience is more valuable than academic experience and, if they do stay on, they may lag behind their fellows in experience and salary. This is unfortunate in my view, particularly in regard to research for the M.Sc. degree. M.Sc. research is essentially practical in nature, and the primary objective of the course is teaching the young graduate how to tackle an investigation on his own. He is required to plan the investigation in such a way that he can draw logical conclusions and rely on his own assessment. These are skills that must surely be very valuable to the graduate in industry, and the mining industry must ultimately review its current policy in this regard. It must be remembered that post-graduate students form an integral part of the research effort in the university. If that research effort is to remain viable, relevant, and sensitive to the real needs of industry, a steady stream of post-graduate students must be assured.

A recent innovation within the university structure is the arrival of Black students who seek careers in the mining industry. The year 1981 saw the enrolment of the first Black students in the Department of Metallurgy and, despite continuing governmental pressure on Wits with respect to its intake of Black students, it must be expected that a steady stream of Black students will come to Wits for their education. Wits has a strong commitment to maintain a completely non-discriminatory policy on student admissions, and will continue to encourage all qualified Black students to enroll. The industry is expected to take the necessary steps to ensure that Black graduates are assimilated into the industrial scene in a non-discriminatory way immediately after graduation so that they too can play their part in the development of the metallurgical industry. In this field, we face a terrible legacy of indifference to the real educational needs of Black South Africans. The alienation from White institutions that is felt by young Blacks as a result is a very real barrier between the industry and a potentially rich source of professional talent. Wits can and will bridge this gap — not least because it has maintained some measure of credibility among the younger generation of Black scholars. But without the ultimate support of industry, Wits will lose whatever credibility it still has.

The single most pressing problem that faces both the university and the industry is the lack of interest shown by matriculants in the metallurgical industry as a career. The output of graduate metallurgists from all South African universities has, for many years, been insufficient to satisfy the needs of the local industry. The shortfall has always been made up by the employment of immigrants. While this has been satisfactory on the whole, both the industry and the university have sought to improve the recruitment of students into metallurgy. The Chamber of Mines, together with the Institute, has maintained an ongoing effort to improve recruitment. The Phoenix programme, which has sought primarily to increase awareness and knowledge about the mining and metallurgical industries among school teachers, has made it easier to find matriculants who are receptive to the possibility of a metallurgical career. However, an enormous effort must still be maintained annually to ensure that individual matriculants receive appropriate information about the career prospects in the industry. During 1983 alone, the Department of Metallurgy has made direct contact with more than 300 pupils who have expressed some interest in metallurgy as a career. This is an activity in which a close contact has been maintained between academics and industrialists, and the financial resources made available by industry have improved the position considerably. Much remains to be done in this field in the future, and a continuing effort will be required by industry and the university for many years to ensure that the Department of Metallurgy remains viable with respect to student numbers. Without an adequate supply of students, the Department is vulnerable and has lost resources, particularly laboratory space, to the other more popular engineering departments in recent years. It is in the interests of both the industry and the university to reverse this trend, and that will be a major target in the years ahead.

Conclusions

The industry has been well served by the university, which in turn has been well supported by the industry.

The present relationship is very healthy, and encourages industry-related teaching and research activities at the university. The role of the research organizations is particularly important.

The relationship promises to develop very soundly in the future.

The Institute plays a catalysing role and creates an important point of contact between the industry and the university.

Poor student enrolment is certainly the most pressing problem that faces the university, and a coordinated effort is required from the industry, the Institute, and the university if a steady stream of talented young people is to seek careers in the South African metallurgical industry in the future.

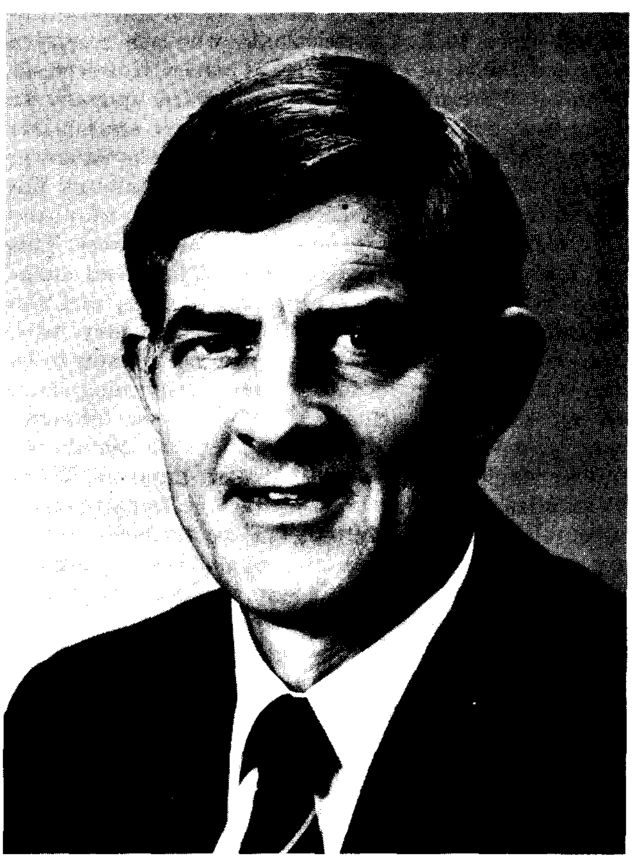
References

1. Daniell, J. School of mines for the Witwatersrand. *Proc. Chem. Met. Soc. S. Africa*, vol. 2. 1897. pp. 156–163.
2. Lawn, J. G. A school of mines for the Witwatersrand. *Proc. Chem. Met. Soc. S. Afr.*, vol. 2. 1898. pp. 208–213.
3. Richards, C. S. *The iron and steel industry in South Africa.* Johannesburg, Witwatersrand University Press, 1940, Chap. 1.
4. Stanley, G. H. Some experiments on smelting titaniferous iron ore. *J. Chem. Metall. Min. Soc. S. Afr.*, vol. 10. 1909–1910. pp. 162–172, 345–352.
5. Richards, C. S. *Op. cit.*, p. 54.
6. Stanley, G. H. Iron and steel in the Union of South Africa. *S. Afr. J. Indus.*, Dec. 1917.
7. Stanley, G. H. Presidential address. *J. Chem. Metall. Min. Soc. S. Afr.*, vol. 15. 1914. pp. 24–34.
8. Stanley G. H. Letter to Government Mining Engineer dated 1933. File 5/320 TES, vol. 982, Government Archives, Pretoria.
9. Mavrocordatos, C. E. Some thoughts and reflections on the training of metallurgists. *J. S. Afr. Inst. Min. Metall.*, vol. 60. 1960. pp. 566–575. Discussions *Ibid.*, vol. 61. 1960. pp. 47–53.
10. Gaudin, A. M. *Principles of mineral dressing.* New York, McGraw-Hill. 1939.
11. Taggart, A. F. *Handbook of mineral dressing.* New York, John Wiley, 1945.

New President of FSPE

Dr B. v. D. Boshoff was elected President of The Federation of Societies of Professional Engineers on 1st July, 1983.

Burrie van Dyk Boshoff was born in Middelburg, Transvaal, on 18th December, 1937. After he matriculated at Afrikaanse Hoër Seunskool Pretoria, he obtained a B.Sc. degree in Agricultural Engineering from the University of Pretoria in 1960. In 1965 he completed a Master's degree in Engineering from the same university. After three years' study in the U.S.A., he obtained a Ph.D. degree in the Department of Biological and Agricultural Engineering at North Carolina State University at Raleigh (1969) with a thesis entitled 'Automatic depth control of seed planter based on soil conductance sensing'.



New President of FSPE, Dr B. v. D. Boshoff

During 1961 he was appointed Zone Manager for northern and eastern Transvaal for International Harvester Company. In 1963 he joined the Department of Agriculture as engineer, and was appointed Assistant Chief Engineer in 1976 and Chief Engineer in 1977 with the Division of Agricultural Engineering, a position that he still holds.

He was responsible for the Division's first official tests on agricultural engineering equipment, and subsequent to those reports, published in 1971, he was responsible for several other official test reports that have been published over the past twelve years.

During 1974 he was appointed a visiting scientist on the staff of the University of Illinois at Urbana, and worked with the Department of Agricultural Engineering and extension officer of mechanization trends in the U.S.A. Since 1961 he has produced various publications, and authored and co-authored several popular scientific papers.

He is a Past President of the South African Institute of Agricultural Engineers (SAIAE) and was Secretary of that Institute during 1972 and 1973. At present he is Chairman of the Education Committee of FSPE.

Dr Boshoff was married to Susara Skinner in 1965, and they have two boys and two girls.