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120 years

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Celebrating 120 years of SAJS: Reflecting on yesterday, embracing tomorrow

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This special issue, 'Celebrating 120 years of SAJS: Reflecting on yesterday, embracing tomorrow', is a commemoration of 120 years of continuous publishing of the Journal, albeit with changing formats and changing names. Contributors to this special issue reflect on the history of the Journal and its role in the history of South African science, in ASSAf and in the mentoring of early-career researchers.

Cover image: The many 'faces' of the SAJS through the last few decades. The larger, framed covers of the Journal are those that were selected as 'the best' of each decade by SAJS readers and social media followers. Cover design: Nadia Grobler.

The resilience and challenge of 120 years

This special issue celebrates 120 years of continuous publishing of our Journal, in changing formats with slightly different names. We are very fortunate indeed not only that Jane Carruthers, the eminent South African historian of science, served as the immediate past Editor-in-Chief of the Journal, but also that we were able to prevail upon her considerable generosity and expertise to publish with us what she terms a 'biography' of our Journal. This long story makes fascinating reading, and also provides an authoritative account of key issues of the history of science in South Africa.

Arranged around this central piece for us are a number of other contributions from key role players, past and present. Wieland Gevers has played and continues to play a key role in the history of science of South Africa, and we are lucky that he agreed to provide us with a set of reflections stretching back a number of decades. Each of the living Editors-in-Chief has provided a Commentary, and we have Perspectives on most areas of research commonly covered in the Journal as it is today, as well as on our mentorship programme, and on the view of our Journal from our Managing Editor and from the broader ASSAf perspective.

Probably not surprisingly, some of those we asked to provide commentaries for us initially answered that they did not feel equal to the task of providing overviews. As we shall discuss later, the problem of accounting for and presenting what readers may view as a fair overview is a daunting task, especially for all of us who are not historians, let alone historians of science. Readers will see some sharp variations in style and in how authors approached their commentaries. We believe this diversity is in itself helpful to see, as we are a journal of many views, debates and approaches. We are also very much aware of how much more there is to be said and argued about regarding the past, present and future of our Journal. As always, we welcome contestation, debates and filling of crucial gaps where this special issue of the Journal is silent. As a journal, we aim to be anything but a remote authority dictating to our readership how to see the world; we are proud of our rigorous editorial policies and practices, but we realise that these are nothing unless we are open to many different ways of seeing the world, science, and the performance of our Journal. In terms of the metrics used these days to assess journals, we are grateful to have the highest impact factor of any multidisciplinary journal in South Africa, but these metrics, as we know, are limited and skewed and a poor proxy for quality. A good quality journal, we believe, is open to debate and contestation from our readers.

This year of our celebration of 120 years of *SAJS* – a journal older than the declaration of the Union of South Africa – is also, we are very much aware, the year of 30 years of democracy in our country. We are not the only ones pausing for reflection and celebration at this time. My home discipline is that of psychology, and the *South African Journal of Psychology* is due to publish a special issue later in 2024 to coincide with 30 years of the establishment of PsySSA, the Psychological Society of South Africa, established at a critical moment in the divided history of our country, with a view to serving a future democratic country. In a reflective piece on this 30-year history,[1] past PsySSA presidents frankly discuss some of the social and political challenges associated with a professional and scientific practice in our country historically intertwined with histories of colonialism, racism (including scientific racism), sexism, and a number of other challenges. These authors make it clear that the struggles for change and for answering the question of what a psychology appropriate to the needs of our country and continent are far from over. The same, of course, is true for our Journal, although the challenge may be even greater given the diversity of views and approaches in the breadth of work we consider and publish. As Jane Carruthers indicates in her article, our Journal has been nothing if not resilient; what is perhaps more difficult for us to think about collectively is what has been achieved and what has not yet been achieved in service of fundamental questions about equity in South African science – equity in access to science, in setting scientific questions and agendas, and in benefitting from science. This includes existential questions about our species' future life on this planet, and that of other species. We are very grateful to our authors over the years in helping us address and build equity, in line with both ASSAf and *SAJS* policy; none of us, we imagine, pretends that we have solved all the challenges.

In this regard, it may be helpful, we believe, for many readers of *SAJS* to read the discussions in the conversation on post-apartheid South African history convened in *The Journal of African History* by Jacob Dlamini[2]; many readers of this Journal will also recall Dlamini's important ASSAf Humanities Lecture, appropriately titled 'Crisis and catastrophe: The motor of South African history?'. Most of us at *SAJS*, as we have mentioned, are not historians, and may struggle with history. As scientists interested in interdisciplinarity, many of us are aware of the unreliability of memory in general, and the importance of a range of neuroscientific and other approaches to understanding memory of various kinds.[3] We also know (and this is more clear than ever in the current 'post-truth' era, as some have described it[4]) how politics deeply affects how and what we remember, in the South African context and elsewhere[5]. Taking due account of the vagaries of history and memory, we can easily view the progress of South African science and academic life as a remarkable victory or a great tragedy, even when reading side by side two books written recently by one of South Africa's most important public intellectuals.[6,7]

Putting together this special issue has reminded us at *SAJS*, yet again, of the importance of interdisciplinarity and of the necessity to be self-critical and reflective. We are resilient, but we have not yet done enough. For 90 years our Journal flourished under colonial and, subsequently, apartheid regimes (with many scientists resisting oppression); this longevity must be celebrated, but the celebration is also complex and must be intertwined with the knowledge of how power, privilege, and exclusion cannot but be intertwined with our success. We may all in some ways have been breathing a collective sigh of relief for the past 30 years, years of democracy. But this does not put us beyond history. Writing in the Dlamini et al.[2] discussion, for example, the celebrated South African social scientist and historian Shireen Hassim notes:

> *I would say we have hardly begun to consider how the decolonisation of South Africa today would differ from its predecessor two generations ago: what it would offer, in other words, beyond calling for centring African experiences, amplifying voices from below, critiquing capitalism, and lionising black popular politics and resistance movements?* (p.9)

Hassim and her colleagues note the importance of engaging deeply with history, and with being self-critical about the context of all South African research, our research of the past, present and future. Part of the history of privilege in South Africa is the privilege that we at *SAJS* have in being the ones to tell the tales of science in South Africa. This is very lucky for us, but also a responsibility of which we are increasingly aware, as we 'reflect on yesterday and embrace tomorrow'.

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The *South African Journal of Science*: A biography

This article provides a chronological account of the *South African Journal of Science* (*SAJS*) from its inception in 1903 up to the present. This approach clarifies the shifts in emphasis and purpose as the Journal moved through changing publishing structures. Over the course of a century, the *SAJS* evolved from a publication that included both lay and professional contributions into a formal professionalised scholarly journal while retaining its accessibility. Originally appearing as the *Report of the South African Association for the Advancement of Science* (S_2A_3), for many decades the content presented the work of people with scientific interests, as reflected at the Annual Meetings of the S_2A_3 convened at various locations around southern Africa. Its objective was to serve as a means of communication between scientific workers in all fields and at different levels and not to restrict itself to publishing erudite original findings alone. A further aim was to communicate interesting evidence-based knowledge to the general public, thereby linking science to broader society. From those beginnings, the article traces the numerous changes in format, regularity, quality and financing over a century. As science and scientists became more formalised in South Africa, editorial disciplines were introduced, and higher quality contributions were solicited. Financial considerations thrust the Journal under different publishing umbrellas. Authors became more professional and disciplined in their publications. This article chronicles the development of the *SAJS* into the open-access scholarly multidisciplinary journal it is today.

Significance:

This work contributes to the history of scientific publishing and scientific institutional history in South Africa. Previous literature in the field of the history of science has made use of contributions to academic journals as sources, but this article on the *South African Journal of Science* shifts attention to the publication itself to focus on South Africa's most important multidisciplinary journal. Its partnership with *Nature* is significant and not generally known. Moreover, this article creates opportunities for further research within the field of colonial and imperial science, nationalism, professionalisation, and links between South African scholarly journals and those published elsewhere.

Introduction

In 1903, the South African Association for the Advancement of Science (S_2A_3, or Association) began publishing the *Report of the South African Association for the Advancement of Science* (*Report*). It was later to be renamed the *South African Journal of Science* (*SAJS* or the Journal). The Journal was conceived to coordinate science and scientists – in any branch of knowledge – as a new era began in southern Africa with Britain in control of the overall region after the defeat of the two Boer republics in the South African War (1899–1902). Its aim was to serve a specific local community and disseminate the breadth of scientific findings through Annual Meetings that were followed by a regular serial publication. With Volume 16 (1920), the title was altered to *The South African Journal of Science comprising the Report of the Annual Meeting of the South African Association for the Advancement of Science*. This title persisted, at times with a slightly changed word order, or with the meeting venue being noted in the subtitle. The subtitle was dropped in later decades. The Journal became bilingual – English and Afrikaans – in the 1920s but reverted to English in recent years.

At the time of the Journal's first appearance, communication between scientists was not easy. Debates via correspondence took time, travel was difficult, but even more importantly, there were no universities in southern Africa through which camaraderie could develop by way, for example, of annual symposia and conferences. The University of the Cape of Good Hope had been established in Cape Town in 1873, solely as a local examining body modelled on the University of London. A number of constituent colonial colleges provided tuition, but they were uneven in staff qualifications, disciplines taught, facilities, student numbers, and standards of teaching and learning.[1,2] Pre-eminent among them was the South African College in Cape Town.[3]

Although the life of the *SAJS* has been intertwined with those of the S_2A_3 and the Academy of Science of South Africa (ASSAf), it is not the purpose here to explore the paths of either of those institutions in detail nor to chronicle their activities beyond publication of the Journal. Those stories have been told elsewhere.[4-10] Concentrating specifically on the long life of the *SAJS,* however, provides an opportunity to analyse a little studied aspect of the history of science in South Africa, namely that of serial publications such as scholarly journals. Hard copy issues of the *SAJS* are held in numerous university and other formal repositories and are to be found bound together appropriately, but not identically, in volumes by those institutions over the years. Many issues of the Journal, but not all, have been digitised and are available freely online. There have been semi-regular composite indexes to the Journal of which that by Isaac Isaacson ([1914]–1974), Librarian and Archivist at the University of the Witwatersrand (Wits) for 44 years[11], published in 1959, is the most useful[12]. Every issue of the Journal contained a detailed index of authors and topics. While the *SAJS* was owned and published by the S_2A_3, the records do not disentangle the two and there is no separate archive relating specifically to the Journal. It is therefore the contents of the Journal that provide the core of the reference material that informs this article, together with the secondary literature that is cited. Although still in existence, the Association has lost its stature and popularity in recent years[9] and, as often is the

case with voluntary organisations, many of the records were scattered with the changes in committee membership and office-bearers. At some time in the past, however, according to Cornelis Plug in an email to the author (3 December 2023), a few of the records of the Association were donated to the Historical Papers Research Archive at Wits. These have been consulted.[13] Many of the public records and reports of ASSAf, the current owner and publisher of the Journal, are freely available online through the ASSAf website, but confidential documents are not available in a formal archival repository.

The history of science is of growing professional interest to historians of South Africa. While some of the literature makes use of periodicals as source material, it has not yet treated scholarly publications as scientific institutions in their own right or as worthy of record. This theme is growing in importance. Harvard historian Melinda Baldwin's *Making "Nature": The History of a Scientific Journal*, which inspired the present article, is well worth noting because of *Nature's* influence on the *SAJS*, and also as an example of the scholarly literature within which this article is framed.[14] As summarised by Sverker Sörlin, with financial backing from Macmillan – a family publishing firm established in 1843 – *Nature* entered the market in 1869 when many predecessors had failed. Only after many decades did it publish what might be termed 'serious' science. *Nature's* story, like that of the *SAJS*, chronicles "a birth, a childhood ... crises, revolts and reforms, it matures ... becomes respected, even admired"[15]. The longevity and multidisciplinarity of the *SAJS* provides an excellent illustration of how one particular journal has evolved since 1903, within a specific historical context, and weathered financial and editorial difficulties until its current nesting within ASSAf.

The existence of scholarly periodicals, in the formats and with the characteristics we observe today – including original research, regular appearance, rigorous editorial supervision, anonymous peer review, references and sources, ethical constraints, citations and other metrics – is often taken for granted. Perhaps it may even be assumed that this structure and format are of long standing, fixed over the years. This is not so. As Alex Csiszar, Harvard historian of scientific communication, has laid out, the academic journal with which we are now familiar was created from a plethora of various publications, formats, and ideas that coalesced only in the 19th century. Over the course of the 20th century, they have not only increased exponentially in number, but have become standardised and, in today's world, they are also required to be economically viable, even profitable.[16(p.1)]

Another study that informs the present article is that by Fyfe et al., in which the authors explain that scholarly journals now offer "organising principles of an entire system of free enquiry ... define and police disciplinary communities ... provide a structure for scholarly careers and the allocation of scientific prestige," but they emphasise that this is what they have become, not what they have always been.[17]

Csiszar has also observed, and this seems to be exemplified in the function of the S_2A_3's Journal, that a key concept of scientific literature, distinguishing it from myth and hearsay, was that it "embodied a powerful image of the collective knowledge of experts and of the orderly progress of knowledge"[16(p.242)].

The *SAJS* began as a colonial publication with intentions both to highlight knowledge in the southern African colonies and also to expand the reach and impact of that knowledge, particularly with the encouragement of local expertise. The words of Sir David Gill (1843–1914), Her/His Majesty's Astronomer at the Royal Observatory in Cape Town from 1879 to 1907 and the first President of the S_2A_3, are worth recalling. Gill wrote in 1905 that "with the recent importation of men of trained scientific capacity, as Professors in our colleges, or Government experts, and now with a few sons of the soil who have been trained by them, there is evidence of a marked increase in true scientific work, and a hopeful prospect of more"[18].

Scholarly societies in South Africa: 1820–1900

Because the *SAJS* has been linked to a scholarly organisation over the century, it may be useful to explore this historical background in South Africa. Such institutions and accompanying publications became features of learned communities as Western science began to move towards what has been referred to as the "new" or "experimental philosophy"[19(p.4)].

Notable early examples appeared in Europe in the 1600s, particularly in Britain – where *Philosophical Transactions of the Royal Society of London* was first published in 1665 – as well as in France and what was to become Germany. It was imperial Britain, however, rather than Europe that provided the institutional model for southern Africa when, in the early 1800s, the Cape came under British control and settlers modelled their locally based intellectual institutions on those with which they were familiar in Britain.[20] In the 1820s, numerous scientifically and literary-inclined societies were established in the Cape Colony, the structure and foci of which harked back to what the colonists had encountered in Britain. Many of them have been identified and described by Bregman[20], Plug[21,22], Carruthers[23] and Dubow[6]. But as the 19th century drew to its close, a group of "men of science" with cultural and social authority in Cape Town formed the South African Philosophical Society in 1877. In 1878, they began the *Transactions of the South African Philosophical Society* in order to publish original research.[24] This was the first South African journal devoted entirely to what was formally referred to as "science" and its appearance marks a significant development.[25] Le Roux has discussed some aspects of the history of the *Transactions of the Royal Society of South Africa*, the successor to the *Transactions of the South African Philosophical Society,* and makes points worth noting.[25]

Around this time, technical sciences emerged in the southern African subcontinent and grew in intellectual and economic importance. This new thrust did not originate from colonial Cape Town, which had been the centre of cultural life. The mineral revolution – the discovery of diamonds near Kimberley in the 1860s and major gold mines on the Transvaal Witwatersrand in the 1880s – had altered the trajectory of knowledge in southern Africa as well as its economic and political destiny. Settlers from various parts of Europe flocked to the mines, revolutionising life for white and black people alike. The economy beyond the Cape boomed as industrialisation and technological sophistication burst upon southern Africa. With the arrival and settlement of thousands of immigrants, voluntary or semi-professional societies affiliated to many disciplines and interests were established in various towns.[21,26]

The establishment of the S_2A_3 and the *Report*

The cataclysm of the South African War brought irrevocable changes to the region. While some institutions had referred to themselves as "South African", as the South African Philosophical Society and others had done, they were almost entirely Cape-based and Cape-focused. Between 1902 and 1910, integration of the then four British colonies was regarded as inevitable, and indeed, the Union of South Africa came into being in 1910. The scientific primacy of the Cape was threatened by intellectuals in the Transvaal, the hub of the mining industry. While eminent Cape scientists were mainly astronomers, botanists, and people in other natural sciences, the applied fields – engineering, metallurgy, or geology – were growing in the industrialising Transvaal.[23]

In the expectation of some form of post-war political partnership among the four colonies, moves towards more cohesion in scientific matters were initiated. Perhaps surprisingly, they came from the engineering community. Until 1902, when peace was declared, the South African Philosophical Society in Cape Town was the leading scientific organisation. Thereafter, it began to reorganise itself as the Royal Society of South Africa, culminating in the grant of a Royal Charter in 1908.[23] While the South African Philosophical Society was transforming itself, others were moving forward with different ideas.

Founding a new learned society in 1902 after a devastating war was an act of courage in the years described by Theodore Reunert (1856–1943) as a "time of great and almost universal despondency"[27(p.141)]. Reunert was a prominent member of the Chemical and Metallurgical Society of South Africa, formed in Johannesburg in 1894.[21] British-born, he had studied engineering at what is now the University of Leeds and was a talented engineer whose expertise straddled many fields, an entrepreneur

whose company still exists, a man widely published in journals and books, and one keenly interested in technical education.[28]

The establishment of the S_2A_3 is recounted by Reunert in his unpublished autobiography:

> *... And that brings me back to the Boer War and the new interests I took up during my enforced residence as a refugee in Cape Town where, meeting for the first time a number of men in my profession who at ordinary times were scattered far and wide, I proposed forming a South African society of engineers and allied professions. The proposal came to the notice of Sir David Gill, His Majesty's Astronomer at the Cape, and he said, 'Why not go a step further and found a society after the pattern of the British Association?' And so he and I having become friends, were the main promoters of the South African Association for the Advancement of Science which held the first meeting in Cape Town in 1902 with Sir David the first President.*[29(p.131)]

At that inaugural meeting in 1902, Gill outlined the objectives of the Association, and the values then elucidated would infuse the Annual Meetings and the published *Report* that followed. The intention of the S_2A_3 was not to be a rival of, or competitor to, academies such as the Royal Society of South Africa, with its strong base in Cape Town, whose *raison d'être* was to publish original research and honour outstanding scientists, nor was it to challenge societies catering to specialised disciplinary fields. Many S_2A_3 Members remained active in other scholarly bodies. The mission of the S_2A_3 was less exclusive, more democratic and collegial, and also more regional in representation and diverse in the scientific fields it embraced as well as the quality of its published output. Unlike an academy, there were no barriers to membership except the payment of a membership fee, no CVs needed to be provided or professional affiliations necessary. Gill summarised its work as "... one of our chief functions is to bring together once a year (now at one centre in South Africa, now at another) not only the working members of the various scientific societies throughout the country, but all who are interested in science either in an active or in a sympathetic sense"[30]. As well as the Journal, a quarterly Bulletin gave news of Members, branch meetings, and other informal information.

Issues of the Journal reveal that annual gatherings lasted up to a week, were generally held in July each year, and ample time was allocated to field excursions, civic receptions, and social functions (all of which are described in the *Reports*). Meeting in this way created opportunities for nurturing friendships and stimulated a sense of a regional scientific community. Members of the Council and other S_2A_3 elected office-bearers were geographically representative of the subcontinent, while the range of scientists and disciplines was calculated to create a sense of political and scientific inclusivity. Scholars from entirely different areas of interest thus mingled in person, while local people, including the youth, were also involved and welcome to listen to presentations in the different centres in which the meetings were convened. The *Report* was intended not only to convey scientific facts, but to act as a means of communication and of introducing intellectually inclined people to one another.

The *SAJS:* 1903–1940

The first Annual Meeting of the four Sections of the S_2A_3, held in Cape Town in 1903, was described in *Nature* as "a British Association gathering in miniature"[31]. The announcement that the illustrious British Association for the Advancement of Science (BAAS, founded 1831) would visit southern Africa two years later energised the new S_2A_3 because it would host a large visiting delegation – 200 people – and parade the scientific opportunities the subcontinent could offer.[6] The important scientific prospects of southern Africa were reiterated in 1929 in the S_2A_3 Presidential Address of J.H. (Jannie) Hofmeyr (1894–1946) who emphasised its growing "South Africanism" since 1905 as well as its potential for wider "Africanism"[2,32]. More than a century later, in 2008, the then Editor of the Journal could note the "remarkably rich laboratory for scientific investigations that southern Africa represents", itemising the natural world, both terrestrial and marine, diseases, the southern skies, the climate and atmosphere and, importantly, the "great diversity of human cultures"[33].

Before the BAAS visit, two Annual Meetings of the Association were convened, the first in Cape Town in 1903, the second in Johannesburg in 1904, and each was followed by a *Report*. Each meeting of the S_2A_3 was divided into Sections describing a suite of related fields of enquiry. There were four Sections in 1903 and their number and arrangement changed over the years. In 1903, 16 papers were presented in Section A (Astronomy, Chemistry, Mathematics, Meteorology, Physics), 11 in Section B (Anthropology and Ethnology, Bacteriology, Botany, Geography, Geology and Mineralogy, Zoology), 8 in Section C (Agriculture, Architecture, Engineering, Geodesy and Surveying, Sanitary Science), and 11 in Section D (Archaeology, Education, Mental Science, Philology, Political Economy, Sociology, Statistics). The first *Report* comprised 46 papers and 556 pages and printing and distribution were onerous tasks.[34] At every meeting, the elected President (a different incumbent each year) gave an Address that generally described the state of science, or its potential in the region, while the (also elected) Section President did the same for their disciplinary grouping. The first *Report* was overseen by a Publications Committee of seven people, of whom the Chair and Editor was the Rev. Dr William Flint (1854–1943), Methodist minister and Librarian of Parliament in the Cape Colony.

The process of paper acceptance and publication was outlined in the 1903 S_2A_3 Constitution. In short, papers of suitable length were scrutinised by the various Section Committees at least a fortnight before they were presented at the Annual Meeting. Thereafter, those Committees would hand papers for publication to the General Secretaries to be forwarded to the Council ahead of printing.[35]

The second Annual Meeting, in 1904, was held in Johannesburg under President Sir Charles Metcalfe (1853–1928), a civil engineer. The *Report* was edited by George S. Corstorphine (1865–1919), at the time the Consulting Geologist to Consolidated Goldfields, and Edmund B. Sargent (1855–1938), then Director of Education in the Transvaal. It, too, resulted in a very large volume with issues appearing monthly and mailed to Members as soon as they appeared in print. The S_2A_3 had no corporate financial backing and thus relied principally on its members' subscriptions to fund the *Report.* The volumes record that governments of the four colonies (later provinces) were regularly approached for additional financial aid, but although this was frequently forthcoming, it was neither reliable nor sufficiently large. Initially, Members of the S_2A_3 paid an entrance fee of £1, then an annual subscription of £1. Reprints from the *Report* were available for a small fee, and the public could purchase a single issue for two shillings from the Association. In 1932, in reporting on the 30th Annual Meeting of the S_2A_3, held in Durban, editor H.B. Fantham (1876–1937), Professor and Head of the Department of Zoology at Wits, advertised, in *Nature*, the price of Vol. 29 as 30 shillings for those who wished to purchase it.[36] Copies were sent to paid-up members and to exchange libraries (see below). In the early 1920s, to save costs, issues were published quarterly rather than monthly, and in 1926 it was decided to publish a single annual volume, although it was also bi-annual for a time. These volumes were all substantial in length, usually between 500 and 700 pages a year.

There were sporadic difficulties in publication. Financial woes beset the Association as early as 1907, when a long Depression followed the South African War. The *Report* was the major expense of the Association, costing the large sum of £422/12/0 in 1906[37], and almost doubling to £740 by 1921[38]. In 1920, for example, the question of raising subscriptions and accepting advertisements was discussed, and it was decided that the incoming council would consider measures to increase revenue to fund the publication. However, there were very few editorial expenses because all official positions in the S_2A_3 and in the production of the Journal were entirely voluntary.

Convening the joint Meeting with the BAAS in 1905, mentioned above, was a huge undertaking for the Council of the S_2A_3. With Theodore Reunert, the President at the time, the visitors were treated to a tour of the region and celebrated wherever they went. Dubow has argued that the 1905 visit of the BAAS was "intended to confer status on the

newly constituted S_2A_3" but it also served to cement relationships among scientists within the budding Union of South Africa as well as with those in Britain.[6] The enormous *Report* that followed was published in four volumes – *Addresses and Papers read at the Joint Meeting of the British and South African Associations for the Advancement of Science held in South Africa 1905 – Being the seventy-fifth meeting of the British Association and the Third Meeting of the South African Association* – and was edited by H.T. Montague Bell (1873–1949), well-known journalist and compiler of various annual publications. In addition to the four volumes, the S_2A_3 published its own separate *Report*, Volume 3, that combined its third Meeting in Johannesburg in 1905 with the fourth in Kimberley in 1906, under the editorship of Flint.[35] Before the BAAS visit in 1905, the S_2A_3 prepared a handbook for the enjoyment and instruction of the visitors to give them an overview of "science" in the region.[18] In 1929, for the second visit of the BAAS, the S_2A_3 – referring to itself as 'the South African "British Association"' – prepared a similar volume updating the "progress" of knowledge in the previous two decades.[39]

In perusing the many volumes of the *SAJS* one discovers that the team of volunteers responsible for the *Report* changed regularly until a formal editorial position was created in the early 1920s, but the role of editor was not, in these years, a prominent or visible one. There were no editorials or editorial opinions; it was the Addresses of the S_2A_3 President and Presidents of Section Committees that were thoughtful and often important.[2,40] Names of the various editors involved were sometimes, but not always, printed in the *Report*, and in the early years it seems that a local scientist and a selected team dealt with papers emanating from the meeting held in their locality. For example, Corstorphine and Sargent, mentioned above, who edited the Johannesburg Volume of 1904, and Selmar Schonland (1860–1940), Director of the Albany Museum and Professor of Botany at Rhodes University College (founded 1904), edited the *Report* of 1908 that related to the Grahamstown meeting that year together with a Publications Committee of six colleagues.[41]

Without interruption during World War I, the Journal records Annual Meetings that took place in many regional centres, so as to be geographically representative, and voluminous *Reports* were subsequently published in serial form. From 1903 to 1910, as the Reports describe, locations included Cape Town (1903) and Johannesburg (1904), while 1905 marked the visit of the BAAS with meetings convened in different centres. Until 1939, the Annual Meetings were held in many towns in the region, not only within the political borders of the Union and often in minor centres. In this regard, in the early years, one might mention Bulawayo (1911), Lourenço Marques (now Maputo) (1913 and 1922), Salisbury (now Harare) (1927), Windhoek (1937) Oudtshoorn (1925), Caledon (1930), Barberton (1933) and Paarl (1935). In 1929, when the BAAS paid another visit to South Africa, the delegates again perambulated around the region.[6]

Leafing through the many volumes of the Journal, it becomes evident that taking a week of the working year of a scientist, whether employed in government, education, or engaged in personal research, was a considerable commitment and personal expense. Many Members of the S_2A_3 seem to have used their vacation leave in order to attend and present their papers. Communication with fellow scientists and the public, who could listen to the papers and also attend the social gatherings, was immediate and personal at these Meetings and was as important as the detailing of discoveries in formal presentations. Moreover, the annual trek from one town to the next (determined a year in advance), involved appointing a voluntary Local Committee responsible for organising the venues, excursions, public lectures, liaisons with mayors and other local dignitaries, all of which are described in the Journal. No doubt, in the dealings of the S_2A_3 with the civic and other local authorities, the importance of science, and of the Meeting itself, was communicated to the different hosting towns and reinforced the importance of science to society. The S_2A_3 Local Committee had a large responsibility in organising the extensive scholarly and local programme, but it was a practical device to engage different places in the shared scientific endeavour through personal interaction. It also provided opportunities for locally significant sciences to be emphasised, such as in towns like Johannesburg in 1904 where the technical sciences predominated and matters like miner's phthisis were discussed[42] or Lourenço Marques (Maputo) in 1913 and 1922 where marine sciences and Portuguese history were central, or Windhoek in 1937, with its focus on geology and desert studies. Thus, the annual location provided something of a theme, ensuring that scientific workers in these places had the opportunity to present and discuss their work, and to take their science directly to very different audiences and publics. And importantly, South African intellectual life was depicted for posterity in the Journal.

One can only admire the amount of work done by the voluntary local organising committees, the enthusiasm and dedication of delegates and the S_2A_3 Members from many disciplines who contributed to the success of the Meetings and to the publication of the Journal thereafter. In addition, the interest of the civic authorities and the public that attended needs to be mentioned and, in connection with the Journal, so does the work of those who did the typing, who were very likely to have been scientists' wives and female secretaries and who are not acknowledged by name.

The expertise that went into the articles appearing in the early volumes did not bring the professional or financial rewards of scholarly publication, or even act as the marker of individual scientific worth – that would come in later decades. Until 1918, there were no formal South African universities to offer regular opportunities for promotion, and there were no citation and other indexes for academic enhancement, let alone monetary subsidies for publications or recognition from institutions like the National Research Foundation with the system of individual ranking based on publication output.[43-49] The contents of the Journal were genuine initiatives by scholars and learned people to publicise their field of study, to disseminate findings locally and internationally, and to boost the image of science generally. The separated Section meetings within the larger Meeting, together with plenary sessions, were ideal to avoid what might have been a mere salmagundi of disciplines, combining, as they did, discussion of related studies at certain times during which scholarly debate might be robust, and the plenary sessions which were of more general interest.

Being a scientist in the first half of the 20th century was very different from what it is today, and the distinction between expert and layperson was less clear. Scholars who contributed to the *Transactions of the Royal Society of South Africa* were acknowledged experts, most often elected Fellows, whose work was original and important. By contrast, many contributors to the S_2A_3 Journal would today be considered "citizen scientists" rather than professionals, and it is clear that even many of the more scholarly articles were informed by work done by amateurs. As the indexes demonstrate, contributions to the Journal were wide-ranging in topic and focus, uneven in length and significance, and many were descriptive and would not qualify today as 'scientific'.[12] There was little regimentation to stifle the eclectic offerings. Published articles did not always have source lists or bibliographies, there were no keywords or abstracts or formal length restrictions. There was also no indication of papers that might have been rejected (if any), although certainly some were not printed owing to costs or perhaps because the authors did not submit timeously.

It is not possible to summarise the contents of these early volumes because they were so extremely varied and straddled all disciplinary fields from archaeology to zoology, but close analysis of a long period of published articles would be academically rewarding. Perusing Presidential Addresses – both of Section Presidents (Sections changed in composition and number) and Presidents of the S_2A_3 – would provide overviews of what might be termed the general state of science.[2,40,50] It would also be worthwhile to follow a particular suite of disciplines, and tracking the growth or decline of subject fields expressed through the Journal would be worthy of research, as would an examination of what papers in the *SAJS* received international attention or even altered the dimensions or trajectories of a particular science.

As just one example, archaeology can be seen unfolding in new directions through the pages of the *SAJS*. Early issues frequently contained pictures or drawings of stone tools or rock art accompanied by speculation on their origins. But by the late 1980s, the new and exciting field of cognitive

archaeology, promoted principally by J. David Lewis-Williams (b. 1934) at the University of the Witwatersrand (Wits), had been established and become well known.[51] Similar developments might be identified in the evolution of many disciplines over the century.

From the beginnings of the Journal there was considerable curiosity about black South African society and the African past, couched though it was in the patronising, even racist, language of its time. Dubow has highlighted many significant addresses and examined particularly how a white South Africa was constructed through science with the Journal playing a part in the topics and perspectives of many of the articles that were published.[52] However, as Journal authorship was not pre-determined by skin colour, nor were there racial hurdles to joining the S_2A_3 or participating in the Annual Meetings (such as an elected Fellowship or Membership that might apply in other societies and institutions), more detailed research on this subject would be rewarding.

By far the majority of authors were men, many of distinction. They included, for example, botanist John W. Bews (1884–1938)[53], geologist Alexander L. du Toit (1878–1948)[54], chemist Paul D. Hahn (1849–1916)[55], educationist Sir Thomas Muir (1844–1934)[56] and veterinarian Sir Arnold Theiler (1867–1936)[57]. The participation of women was welcomed from the start. Among them were botanist Edith Stephens (1884–1966)[58], mycologist Elaine Laughton (née Young) (1898–1974)[59], plant pathologist Ethel Doidge (1887–1965)[60], parasitologists Annie Porter (1880–1963)[61] and Gertrud Theiler (1897–1986), a Section President in 1934[62], and anthropologists Dorothea Bleek (1873–1948)[63] and Winifred Hoernlé (1885–1960)[64]. Maria Wilman (1867–1957), botanist, geologist, expert on the rock engravings of the northern Cape, and the first Director of the McGregor Museum from 1906 (and the second South African woman to attend the University of Cambridge), was among the early contributors to the Journal.[65] Wilman provided photographs from the Cronin Collection in the museum – a rock painting, a rock engraving and a glaciated rock surface – to the *Handbook* prepared ty the S_2A_3 for the second visit of the BAAS in 1929 referred to earlier.[39] Glasgow-educated Mabel Palmer (née Atkinson) (1876–1958) was an economic historian, ardent feminist, and promoter of black and Indian education in Natal, whose articles appeared regularly.[66,67] She was a Section President in 1930 and Vice-President of the S_2A_3 in 1933. There was also Johannesburg-born social activist Hansi Pollak (1905–1982), pioneering social worker at the University of Natal, President of Section F in 1934.[68] During World War II, Pollak was seconded to the United Nations Refugee Relief Association in the Middle East and, a long-standing member of the Institute of Race Relations, she was director of Welfare Services for the World Council of Churches in the 1950s.[69] In later years, other women were prominent, an example being the remarkable palaeobotanist Edna Plumstead (1903–1989).[70] The names of some other authors are equally well known, but condemned for the role they played in South African history. Architect of apartheid Hendrik F. Verwoerd (1901–1966), who contributed an article to the Journal in 1929 when he was Professor in the Department of Applied Psychology at Stellenbosch University, comes to mind in this regard.[71] There were no black people present either on the Journal or within the Association until many years had passed, although there were no institutional impediments to their participation in the Journal or in the S_2A_3. While there were black intellectuals in the late 19th and early 20th century South Africa, the majority were journalists, political activists, and writers. Favoured publishing outlets for this cohort were explored some years ago by Odendaal[72] and by Mgadla and Volz[73]. One can only speculate as to why the S_2A_3 did not attract Western-educated black scholars – such as doctors or veterinarians – or indeed, the educated public, in the years before apartheid when this might have been possible.[74] Flint's Presidential Address in 1919 expresses views that, while patronising, are not entirely derogatory[75] while the biographies of some of the prominent Members of the S_2A_3 indicate their liberal political views for the time. One of the objectives of the S_2A_3 was to promote local scientists, and it would perhaps be useful to survey the national origins, educational backgrounds, and careers of authors in the Journal. In reading through the volumes, one certainly gains the impression that, by the 1930s, there were many more locally born scientists than there had been at the start. Familiar South African figures, like ecologist John F.V. Phillips (1899–1988)[76], archaeologist Clarence Van Riet Lowe (1894–1912)[77], civil engineer R.J. Van Reenen (1884–1935)[78], parasitologist Gertrud Theiler, and others appear in later years.

Although one can discover a great deal about the different South African sciences from reading these volumes of the *SAJS*, it is more difficult to find first-hand accounts of how Annual Meetings and papers were received by participants and subsequently by authors – reception rather than production. No doubt reactions were either verbal at the time or expressed in documents now unavailable. It is for this reason that the recorded response of G. Evelyn Hutchinson (1903–1991) is significant as an instance of one scientist's perspective.

In his later career at Yale University, Hutchinson was a world-renowned ecologist. As a young academic he spent two years (1926–1928) in the Department of Zoology at what was then the new University of the Witwatersrand. While in South Africa, Hutchinson corresponded with his parents in England and his letters are housed at Yale. Although biologists by training, Hutchinson and his wife Grace E. Pickford (1902–1986) became fascinated by San hunter-gatherer culture, and thus were delighted to meet and speak to Dorothea Bleek at the S_2A_3 meeting held in Salisbury (Harare) in 1927. Hutchinson told his parents that the gathering was "a great success, chiefly in meeting people and learning some anthropology. Our section has been very dull; its president [Sydney H. Skaife (1889–1976)] failed to appear, and Dr Annie Porter was installed instead. She has found some excuse to avoid or prohibit a discussion on almost all the papers! Fortunately, people protested, and we had several interesting talks. The most interesting people are undoubtedly the anthropologists...". A highlight was the "Evening Discourse" given by Alexander L. du Toit on 'The Kalahari and some of its problems', which Hutchinson described as "chiefly recent geological history, quite interesting but too long". There were informal discussions, Hutchinson recording that, "We gave a campfire coffee paper one night to the Hoernlés [Winifred and Alfred (1880–1943)] and a friend who were staying at the hotel." While in Rhodesia (Zimbabwe), the couple took the opportunity to visit Great Zimbabwe. "It is a most amazing place," Hutchinson wrote, "but I am now a convert to its Bantu origin in part."[79] It was shortly afterwards that renowned British archaeologist Gertrude Caton-Thompson (1888–1985) published definitive evidence that the site was African built.[80,81] The multidisciplinarity and the personal interaction of the Annual Meeting were beneficial to Hutchinson's intellectual growth, and this was doubtless the case for very many who attended. After every Meeting, the widely distributed Journal appeared as a permanent record to which anyone could later refer.

For Percival R. Kirby (1887–1970), Professor of Music at Wits, the *SAJS* was vital, and in his memoirs he frequently refers to S_2A_3 meetings and to his articles in the Journal.[82] Kirby's research speciality, ethno-musicology, was extremely innovative for introducing an understanding of African music, its instruments, and its theoretical base into the academy. His work relied heavily on African informants and their expertise. Without Kirby's publications over many years in the Journal, it is unlikely that this field would have prospered. Similar developments can be seen in the evolution of many disciplines over the century.

The Journal was also widely available internationally. It was conventional in that era that societies with serial publications not only mailed printed copies to paid-up members or subscribers but participated in extensive networks. Thus, in exchange for despatching the *SAJS* to very many libraries and academic societies around the world, thereby promoting the Journal and its contents, the S_2A_3, in turn, amassed an extremely large collection of similar publications that were housed at first in a special room in the Johannesburg Public Library and later in the Association's separated collection at Wits, only to be destroyed by the fire in the Gubbins Library in December 1931.[83] In 1920, the Journal recorded its collection as being some 250 journals from all over the world, emanating from institutions to which it had sent copies of the *SAJS*.[84] In 1963, the Library boasted 7700 volumes, with 420 titles currently received.[85] WorldCat lists 1643 libraries holding copies of the *SAJS,* although the various dates of these collections are not easy to obtain.[86]

The 1917 Constitution of the S_2A_3 provided for an Editor of the *Report* and, in 1919, the first incumbent was eugenicist Harold B. Fantham. At this time, the Headquarters of the Association moved from Cape Town to Johannesburg where Fantham was based in the Department of Zoology at Wits.[87] While the Editor's role was not specified in detail, one can

surmise that his tasks were those of collating contributions from the various Section Committees and overseeing the printing and despatch, bearing in mind that membership of the S_2A_3 generally hovered around 800, having begun with 69 members in 1901/1902, the number increased to 336 in 1902/1903, although it was admitted that record-keeping was erratic and uncoordinated (and subscriptions were unpaid) and precise figures were difficult to obtain.[88] It is worth recording that in 1913 there were 263 Members in the Transvaal and 230 in the Cape, 24 abroad, 8 in Basutoland, and 1 each in Swaziland and German South West Africa[89], but, by 1925, Cape Member numbers had remained static (214 Members) while in the Transvaal they had increased to 501 in a total of 915[90]. In 1963, the numbers remained comparable, with 1053 members in total, 547 in the Transvaal, 261 in the Cape, 113 in Natal, 35 in Southern and Northern Rhodesia, while 61 were listed as being "Overseas".[91] It was under Fantham's editorship that the *South African Journal of Science* became the title, with the *Report* as a subtitle. The reasons for making this change were not articulated at that time. The S_2A_3 and Fantham may have been influenced by contemporary journals with succinct titles, or perhaps were reminded of the words of Sir Walter Hely-Hutchinson (1849–1913), Governor of the Cape Colony from 1901 to 1910, who addressed the Association when he was President in 1908. As part of his Address, Hely-Hutchinson said:

> *Take, for instance, the question of scientific publications. Scientific papers appear in the publications of various and diverse scientific societies and institutions in South Africa … many are buried in Blue Books if not mummified in manuscript … But there is no such thing in South Africa as a South African journal of science which might serve as a common channel of communication between the scientific workers throughout South Africa, and between them and the general public.*[92]

By the 1920s, the *Report* had taken on some of the attributes of just such a "Journal of Science".

Advertising within South Africa was difficult, but the S_2A_3 also promoted the Journal in *Nature*, probably irregularly. In 1932, for example, editor Fantham gave a detailed summary of the Annual Meeting held in Durban that year that included a mayoral reception as well as excursions to local places of scientific attraction. As it is likely that he included in this report those articles he considered to be of interest to the international community and described to them, it is useful to itemise some of them. Papers read numbered 117; one of the popular evening lectures was by General Jan Smuts on "Climate and Man in South Africa". S_2A_3 President, veterinarian and zoologist Petrus J. du Toit (1888–1967), head of research at Onderstepoort and a promoter of international collaborations particularly within Africa[93], titled his address "Africa's debt to science". Other items Fantham considered worth mentioning were "The geological history of Durban" by L.J. Krige, Director of the Geological Survey; "Particles and Waves" by Richard W. Varder (1889–1973), Professor of Physics at Rhodes University College; "Evolution as a palaeontologist sees it", by Robert Broom (1866–1957); "A survey of our present knowledge of rockpaintings [sic] in South Africa" by Dorothea Bleek, then President of Section E; and "Missions as a sociological factor" by J. du Plessis (1869), President of Section F. (Johannes du Plessis was one of the founders of the Institute of Race Relations in 1929 and a leading activist tor political reforms that would ameliorate the pass laws imposed on Africans. Accused of heresy, he was later dismissed by Stellenbosch University.[94]) Fantham's report is lively and detailed, but it is not possible to assess its impact on subscribers to *Nature* or discover how many might have purchased the *SAJS* volume or read it in a library in other parts of the world.[36]

Fantham remained Honorary Editor until 1933, when he left for McGill University. His replacement was Harold (later Sir Harold) Spencer Jones (1890–1960), His Majesty's Astronomer at the Cape of Good Hope, who vacated the post almost immediately on being appointed Astronomer Royal at Greenwich. He was succeeded by James A. Wilkinson (1873–1934), Professor of Chemistry (and Chemical Engineering) at Wits who, unfortunately, died the following year.

In 1937, Grahamstown-born pioneer ecologist and forester John F.V. Phillips, Professor of Botany at Wits, became Honorary Editor, assisted by Louis F. Maingard (d. 1968), Professor of French and Romance Studies also at Wits, whose research interests lay in San and Khoekhoe linguistics. Phillips introduced many stipulations to which authors had to adhere and there was less flexibility. He gave instructions for concise and original contributions, appropriate but not lavish illustrations, standardised references, and consistent punctuation and grammar. In addition, those who were not Members of the S_2A_3 who wished to have their papers published in the Journal had either to join the Association or pay publication expenses. In 1938, a formal refereeing process was mentioned for the first time – a recommendation from Phillips led to the appointment of a special committee to oversee the process. Thus, by 1940, the *SAJS* had taken on many characteristics of scholarly journals that are familiar today.

The *SAJS:* 1940–1972

Science does not exist in and of itself: it is always rooted in its social and cultural milieu. World War II had totally upset the world order and the Cold War that followed brought further global tension. International science was transformed by the War and created uncertainty about the fate of the *SAJS*. Moreover, politics in South Africa were volatile and in 1948 the National Party gained a surprising election victory. With wartime fuel and paper shortages, and with many members of the Association engaged in military duties, meetings were curtailed in length and the Journal inevitably became slimmer. The 1947 volume, for instance, consisted of some 155 pages, while the average in previous years had been around 700, often more. During the War, Annual Meetings were convened in Johannesburg. Secretarial assistance was available (at a cost) from the Associated Scientific and Technical Societies (AS&TS) situated in Johannesburg and to which the S_2A_3 had become affiliated.[95] In the 1940s an Associate Editor was appointed; this was Samuel. B. Asher (1871–1951), retired Johannesburg City Librarian. For the next few years, Asher kept a close eye on the Journal, constantly reminding authors to follow instructions. At the time, the two official languages were given equal recognition, and the cover and title of the Journal became fully bilingual, as did the Association's Minutes.

Matters specific to the War were published that are now of historical interest. They included, among others, an article in 1943 by mathematician and astronomer Arthur E.H. Bleksley (1908–1984) on "Recent advances in nuclear physics" and "Geology in war and after" by geologist and palaeontologist Sidney H. Haughton (1888–1982), wartime member of many South African government commissions relating to strategic resources. There were also two multidisciplinary symposia that debated the post-war future. The first (1942), "Science and post-war reconstruction", consisted of 12 papers that focused on appropriate planning for the difficult decades that lay ahead. The second (1945), "A scientific approach to the problems of post-war employment", consisting of seven papers, was published as service members were returning and as it became clear that the working conditions of black miners were increasingly intolerable.

The War had demonstrated that government spending was the motor that accelerated technological improvements and military urgency had stimulated many inventions. In South Africa, this manifested itself in the establishment of research institutions such as the Council for Scientific and Industrial Research (CSIR) in 1945 and its ancillaries. Governments began to spend large sums of money on what has been termed "Big Science" – applied sciences on a large scale.[96(p.367-370)]

It is worth mentioning that a more geographically ambitious scientific institution was also established at this time and was one in which the S_2A_3 could participate. Perhaps prefiguring the developmental vision of the later Academy of Science of South Africa (although steeped in a colonial mindset and Hailey's *African Survey*)[32,97,98], in 1950, the Scientific Council for African South of the Sahara came into being and aimed to "advance the interests of Africa"[99]. In 1978, to celebrate the 75th anniversary of the first meeting of the S_2A_3, in the *SAJS* Stanley Jackson praised the establishment of the Council for emphasising the "need to think about education of all races in relation to science and to

think perhaps a bit more carefully about the kind of science that South Africa should do..."[8]. He regretted the short life of the Council, because it prevented Africans from "taking the lead" in defining what types of science were appropriate for Africa. It appears that South Africa's membership in the Scientific Council ended in 1965 (perhaps before) when the institution merged with the Organization of African Unity, which was hostile to the apartheid government, under the name of the Scientific Council of Africa.[100]

Thus, in the 1950s, a new research culture developed in South Africa because of state investment in specialised scientific institutions, but also because of the increase in the number of universities. By 1945, the Universities of South Africa, Cape Town, Stellenbosch, and the Witwatersrand had become full universities, and the university colleges of Natal, Rhodes, Free State, and Potchefstroom were shortly to follow.[44-49] Student numbers post-1945 were also boosted by returning service members. At Wits, for example, there were 2544 students in 1939, 3100 in 1945, doubling to 6275 by 1963.[101] This put far heavier teaching loads onto all staff. The flood of government funding for research and increases in the number of specialised sciences and scientists drove even more publishing activity, principally of specialist journals which were attractive to commercial publishing firms. A competitive market thus developed.

This context also signalled the waning of the large Annual Meetings of the S_2A_3 and affected the format and contents of the Journal.[8] Publishing original research in shorter papers became a driver of career progress and thus the number of researchers and specialised publications proliferated.[102] The perhaps rather gentlemanly British colonial ambience of science, characteristic of the early years of the 20th century and that was emblematic of the S_2A_3 and its Journal, began to fade as the West became more Americanised. "New official agencies and state departments were providing the stimuli that were needed to advance science."[8] Simply put, the convivial Annual Meetings of the S_2A_3 were no longer appropriate, nor was the Journal.

Csiszar has argued that, at this time, "the public status of science was being negotiated" and that peer review – once regarded as stifling innovation[17] – was required to adjudicate where state investments would be made and which project would be supported, and this practice began to permeate scholarly publishing and academia.[103] Baldwin has analysed *Nature* in this period, making similar observations.[104]

The Minutes of S_2A_3 meetings that exist for the 1940s and 1950s and that are housed in the Historical Papers Research Archive at Wits, whether Council, Executive Committee, Publications Committee or Editorial Committee, are replete with fears over the future of the Journal. Costs had risen significantly. It was evident that, in this new world, if it were to survive, the scholarly gravitas of the publication needed to be raised and its content and target market reconsidered. It also needed to become financially stable.

At first, the Association attempted to return to the pre-war status quo. However, managing the Journal became increasingly difficult as volunteers, once plentiful, became reluctant to contribute their more limited spare time to it. Changes in the editorial team were frequent and when, in 1947, Phillips resigned and was replaced by Asher as Editor, there was a radical change in policy. The *Bulletin*, the S_2A_3's quarterly publication, was expanded, published monthly, and renamed *South African Science* while the *SAJS* embarked on raising its quality and slimming its bulk.

After having first appeared in August 1947, it was clear by the end of the following year that this experiment of a second publication was not a success. In May 1949, the Council decided to discontinue *South African Science,* merging it with the *SAJS,* which appeared monthly from August that year.[8,105] A total overhaul was required, but how this might be accomplished was a formidable challenge to those managing the cash-strapped S_2A_3. From 1949 to 1950, Lawrence H. Wells (1908–1980), a Wits anatomist and medical doctor with strong interdisciplinary interests, became Honorary Editor and, when he moved to Edinburgh in 1951, yet another model was introduced with the initiation of an Editorial Board as well as an Editor-in-Chief. This was Stanley P. Jackson (1905–2002), a climatologist at Wits.

Around this time, a change in the basic purpose of the *SAJS* can be discerned. In 1952, Grahamstown-born renowned physicist, and one of the founders of the CSIR, Basil (later Sir Basil) Schonland (1896–1972), was President of the S_2A_3. In his Presidential Address, celebrating 50 years of the Association, he re-emphasised the rationale for the *SAJS*. Having described the new environment in which the Journal and scientists had to work, he said that he continued to believe that providing information to the interested layperson lay at the heart of the Journal, together with the desire to expose specialists and professionals to developments in fields other than their own. He mentioned how the number of journals in the world had risen to many thousands, each year publishing around a million scientific papers. But he now regarded the Journal as a means of encouraging taxpayers to support state-funded science. He lamented that in this "growing mountain of scientific publication" the impact on government policy was not taken into consideration. Without knowledge of scientific developments, or of how and why research money is spent, citizens – and thus their governments and other funding agencies – would, Schonland considered, be reluctant to finance scientific research and this would have potentially deleterious effects on society.[30]

Perhaps the most significant change of all in post-war publishing was the rising cost. In 1895, in the era in which the *Report* had first appeared, the Secretary of the Royal Society of London had declared that "a scientific journal ... is not a profitable undertaking... [they] ... are carried on with great difficulty ... and at a loss ...". In 1957, with corporate interests looming, the Royal Society continued to argue that "Scientific societies must continue to predominate in scientific journal publication, for the moment commercial gain [begins] to dominate this field the welfare of the scientific community would suffer."[106] Nonetheless, it was probably inevitable in the post-war world that the transition to commercialising journals and introducing business-style management and metrics (assisted by computerisation) would occur. As Fyfe recounts, what happened was that, "From a circulation-oriented, mission-driven service to scholarship, funded by learned societies, universities and governments ... [it became] a commercially viable enterprise in the early Cold War." Around the world, there was a "general problem of production and distribution of [journals for ...] original research, which nobody wished to go out of existence, but which without some kind of help were on the way to extinction"[106]. Like many journals, the *SAJS* seemed to be on the endangered Red List, as commercialisation and specialist journals became the order of the day.

While valiantly trying to maintain the traditional approach throughout the 1950s, S_2A_3 committees expressed anxiety about the poor financial situation of the Association and its expensive Journal. Cheaper printers were sought, as were more advertisers, but with little success. Furthermore, the Journal involved a large amount of voluntary work; every paper was considered by a Committee and referee reports (which were mandatory) were discussed, sometimes, then as now, with authors disagreeing with referees and correspondence having to follow. After the Annual Meeting in Lourenço Marques (Maputo) in 1969, for instance, 140 papers had been submitted and, after having been refereed, 81 were accepted and 9 rejected. Gradually, Annual Meetings became more like business meetings rather than large communal gatherings of varied scientists.

The work was onerous for a small group of volunteers, and it did not help that the editorial team changed frequently. Among others, this group included at times, geologist and palaeontologist H. Basil S. Cooke (1915–2018), anatomist and palaeoanthropologist Phillip V. Tobias (1925–2012), physiologist Christine Gilbert, and marine biologist William Macnae (1914–1975), all of them at Wits. Other Wits staff on the Journal included botanist, Communist Party member and (banned) anti-apartheid activist E.R. (Eddie) Roux (1903–1966). In 1955, Muriel J. Hyslop (née McKerrow), a member of the Wits Department of Zoology from 1952 to 1957 and 1970 to 1991, took over as Editor, assisted by an Editorial Committee as well as a Publications Committee.

In addition, the state was beginning to support independent scholarly publications it regarded as beneficial in terms of encouraging or reflecting significant national research. In time, government intervention became very complex. In 1964, the standardisation of page sizes as part of the national decimalisation programme presented a problem for the Journal

which had to alter its format at yet more cost.[107] Overt political meddling came in 1965 when the S_2A_3 and the Royal Society of South Africa, as well as others, were notified that, in order to remain eligible for research grants and other state support, they needed to amend their constitutions to make explicit a requirement that membership be restricted to white individuals only and, presumably, their publications be authored only by white people. Like the Royal Society of South Africa, the response of the S_2A_3 was that, although there were no black members, there was no proscription on the membership of other races and such a stipulation would possibly be detrimental to the aims and objects of the Association in the future. The records of the Royal Society of South Africa reflect that the matter rumbled on for some years, but, eventually, no constitutional change was forced upon either of these two societies.[23,108]

However, more hurdles lay ahead.

By 1966, the alarm was sounded that the S_2A_3 would soon exhaust its funds. If the Journal were to survive, it would have to increase its academic standing and attract more readers. Once more, the editorial team was rearranged and, as well as an Editorial Board, there was to be an Editorial Advisory Board, and an Editor-in-Chief, assisted by two Honorary Editors.[109] The publication was simply not attracting high-quality contributions, and there was a suggestion that instead of waiting for articles to be submitted by authors, such might be invited. In addition, to save expense, publication might be reduced from monthly to bi-monthly or even quarterly.[110]

A further change came about when, in 1970, Nancy W. Van Schaik (1937–2023), née Worner, later Van Heerden, a US-born geneticist who worked at the University of Pretoria and then at Wits, became Chair of the S_2A_3 Publications Committee. In 1968 Hyslop, who had brought some stability to the Editor's position, resigned, and with her departure it was clear that paid professional help was vital.[111] After further discussion, money was found to employ two co-editors (at a combined annual salary of R1000) to produce the Journal. The position of Editor-in-Chief was held in abeyance. The employment of Louis and Kitty Kraft began on 1 April 1970, and this may have been at Van Schaik's suggestion because, through her marriage, she was connected to the Pretoria firm of Van Schaik publishers and booksellers and the Krafts may have moved in these circles. But the crisis was not solved; it became worse. After little more than a year, the Krafts asked to be relieved of their duties as Louis Kraft had become ill. Reading through the S_2A_3 material, housed in the Historical Papers Research Archive at Wits, the worries of those leading the Association at this troubled time are almost palpable.[112]

The language, ethnic, and racial divisions that have characterised South African society and its history were, however, also always at play, and the analysis of scientific societies and their publications within this environment warrants more detailed study. The S_2A_3 had been founded at a time when the British Empire seemed invincible, but after World War II its global primacy was eclipsed by both the USA and the USSR. During the 1920s, when Afrikaans became an official language, the S_2A_3 and its Journal became bilingual, but both membership and authorship appear to have been unattractive to Afrikaans-speakers. In the period from 1903 to 1954, a total of about 33 articles appeared in Afrikaans (as well as two in German and a small handful in Portuguese) from among about 2200 that were in English.[12]

The political problems were exacerbated because the Journal was managed principally by people at Wits, a "liberal" university, and this was not a recommendation for Afrikaans-speaking scientists and readers.[8] More importantly, there was a powerful rival – Die Suid-Afrikaanse Akademie vir Taal, Lettere en Kuns, founded by J.B.M.(Barry) Hertzog (1866–1942) in Bloemfontein in 1909. (In 1941/1942 it was renamed the Akademie vir Wetenskap en Kuns.) Having established the *Tydskrif vir Wetenskap en Kuns* in 1922, in 1960, the Akademie began two Afrikaans quarterly journals in the niche occupied by the *SAJS:* the *Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie* and the *Tydskrif vir Geesteswetenskappe/Journal of Humanities*. From its inception, the political goal of the well-funded Akademie was to develop Afrikaans as a language and to nurture all aspects of Afrikaner culture. With the rise to power of the National Party, established by Hertzog in 1914, the Akademie grew ever closer to it.[113] In 1959, by *Act No. 54 of 1959*, the Akademie was acknowledged in law as the sole national academy for South Africa.[114] In referring to this period, namely 1948–1990, Beinart and Dubow describe it as "an autarkic republic of science and technology", marking a concerted push by Afrikaner nationalists to prove their scientific as well as their cultural credentials.[96(p.264-318)]

Another South African multidisciplinary scholarly journal is the *Transactions of the Royal Society of South Africa*. Consistently supported by its elected Fellows and welcoming long research articles – almost textbook length – the *Transactions* managed to retain its position as a leading multidisciplinary academic journal in the country publishing original work.[25] While in the early decades, the distinction between the Journal and the *Transactions* was clear, with the post-war emphasis on originality and career demands for publication, this became blurred as the Journal tried to find its modern idiom.

The *SAJS:* 1973–1994

To secure the future of the *SAJS*, behind the scenes, matters were moving in quite a different direction from the reshuffling of editors and tinkering with administrative arrangements. Physicist Denys G. Kingwill (1917–1997), an active member of the S_2A_3 and its Publications Committee, became involved. Invited to join Schonland's team in establishing the CSIR, he was appointed Director of Information and Research Services (1962–1983). In that role he frequently visited Britain and there he met the Editor of *Nature*, John (later Sir John) Maddox (1925–2009), former university lecturer and *The Guardian's* outstanding, sometimes controversial, science writer. In 1966, when *Nature* was in difficulties, comparable to those of the *SAJS*, Macmillan, the publisher of *Nature*, had employed the charismatic Welshman Maddox as Editor to restore the magazine's reputation and financial situation. Taking personal charge, Maddox overhauled *Nature* completely by adopting an informal style, clearing the backlog of articles, speeding up publication, taking quick decisions on manuscript acceptance (sometimes without peer review), inserting his own and other opinions on science politics and actively soliciting contributions. Importantly, he introduced newsier sections that included debates and discussions.[14(p.172-175)] Maddox seemed the perfect contact to assist the *SAJS* similarly, and Macmillan seemed interested.

Thus, the decision was taken to convert the *SAJS* into a commercial journal, published by Macmillan, a reputable British company, with subscribers paying a market-related subscription. Negotiations began in August 1971 but were slower than the S_2A_3 had anticipated. Discussions required agreement on the name of the Journal, its regularity, subscription price, and the appointment of a professional editor trained by, or employed by, *Nature* in London. In April 1972, the name of Dr Graham Baker was mentioned as the *Nature* representative/editor for the Journal, but unresolved difficulties continued to plague finalisation of the contract.[115] In June 1972, Macmillan's conditions were agreed in principle, but the matter rolled on without quick resolution.[116] By January 1973, the finances of the S_2A_3 had become critical, with a special Council meeting noting that the Association had completely drained its reserve funds.[117]

The broader historical context is important. By the early 1970s, the grip of apartheid was tightening, but South Africa was not yet completely isolated.[96(p.264-318)] After leaving office as Britain's Prime Minister and predicting "Winds of Change" in Africa, Harold Macmillan identified an opportunity for his publishing company to contribute to education on the continent. Therefore, from both a business and a political point of view, he thought that acquisition of the *SAJS* might be promising. In October 1970, after visiting South Africa as the guest of the CSIR and others, Maddox had written a significant Leader in *Nature* titled "Science is a Trojan horse". He argued there that good research coupled to strong voices would benefit South African scientists in countering apartheid, as would better connections between them and those in the "outside world"[118]. *Nature* had demonstrated its own political courage when it had vehemently criticised Nazi science, leading to its ban in Germany in 1938.[14] Acquiring the *SAJS* thus had potential for accelerating change. Maddox's hope – if that is what it was – that scientists and the Journal would play their parts in dismantling apartheid was, however, not to be realised. In a later article in *Nature* (1987), Maddox reflected on how science had not impacted apartheid as an agent for transformation, and

it was his opinion that the country's intellectual community had been found wanting, never having found a way "to argue the particular as well as the general case against the present arrangements" so as to "change the present climate"[119].

Maddox's own career at *Nature* also had implications for the *SAJS*. As Managing Director of Macmillan Journals, Maddox was innovative and, in addition to widening the range of existing journals, in January 1971 he split *Nature* into three separate publications, rather like the S_2A_3 had done with the *SAJS* and *South African Science* in the late 1940s. He also published *Nature* three times a week, rather than weekly as had been the case for a century. These initiatives resulted in serious financial loss for Macmillan in 1972 and, after disagreements with some of the Directors and complaints from readers, Maddox left the company in 1973 just as it took over the *SAJS*. (He was re-employed in 1980.[14])

Fortunately for the *SAJS*, Graham Baker had already arrived in Johannesburg. He had completed his DPhil in the physical sciences at Oxford in 1970 and had briefly been employed by *Nature* under Maddox. Beginning his work with Volume 69 in January 1973, a new chapter was initiated in the life of the *SAJS*, as Baker started to turn it around. His success was explained by Stanley Jackson in 1978:

> *The editor did what his honorary predecessors had never been able to do. He got amongst scientists everywhere and learnt to know them and what they were doing – in the big laboratories, in industry, in the official agencies and in the universities. What was new and exciting was written up.*[8]

As a young British science writer at the start of his career in South Africa, Baker immersed himself fully in the *SAJS*. As an outsider, he may have found "the present conditions in South Africa as offensive as many residents think them natural" – as Maddox had expressed in 1970.[118] But he made South Africa his home and brought dignity and new life to the Journal.

In its 150 years, *Nature* has had only seven editors and, in emulation of them, Baker was to remain the consummate professional editor of the *SAJS* for 36 years. There is no doubt that his was a difficult task in the political circumstances of the time but, before long, a changed *SAJS* was evident. It became more widely available on a subscription basis, with S_2A_3 members receiving a discount. Given the fresh look of the Journal, its energetic and professional full-time leadership, and the growing imperative among scholars to 'publish or perish', the *SAJS* regained readers and contributors. A novelty was to inaugurate a substantial section devoted to "News and Views" reports on conferences and Book Reviews.

As detailed in the final editorial on his retirement in 2008, Baker had discovered a dismal situation on his arrival. He had been warned that the best scientists did not consider the *SAJS* an appropriate outlet for their work. He found only three articles in the publication pipeline, none of which was satisfactory.[120] With Macmillan Journals now owner of the Journal, the S_2A_3 began to withdraw from day-to-day administration. Baker focused on the scholarly quality of the Journal and, under his direction, it gained support and prospered, growing in both intellectual stature and visual attraction – indeed it became a publication akin to *Nature*.

However, any euphoria over the initial takeover of the *SAJS* by Macmillan Journals did not last long. When Maddox was fired from the company in 1973, the Journal lost one of its champions. After the trial period of a year that was fully funded, perhaps it may also have become evident that the Journal would not be profitable. Thus, towards the end of 1974, it was back within the fold of the S_2A_3. With unwavering support from Kingwill, who had appreciated its potential, the Journal was adopted by the AS&TS and Baker was given an office in Kelvin House. Despite the inauspicious start, in the first issue of 1975, Baker was already able to list the improvements that had occurred under his brief period at the helm. These included a circulation increase of 40%, which improved the precarious financial situation. While a sufficient number of research papers was received, it remained difficult to entice scientists to contribute news items about their activities.[121]

Content and subscriptions were not the only difficulties Baker confronted while he was Editor. State intervention in scholarly publications was about to bedevil the entire sector. In 1976, a Journal Management Committee was appointed, and on it, together with S_2A_3 representative Kingwill of the CSIR as the Convenor, were the nominal inclusions of Bleksley from Wits, and two new members, A. Strasheim (Director of the National Physical Research Laboratory) and F.A. van Duuren (Water Research Commission). With the appointment of the latter two individuals, formal ties between the Journal and state research institutions and their money had begun. A synopsis of the complex situation that developed in the 1970s and 1980s around the many state-funded research journals in South Africa was explained in the *SAJS* by Pouris and Richter in 2000. They authored a comprehensive investigation between 1998 and 1999 commissioned by the Department of Arts, Culture, Science and Technology (DACST) into the role of government in scholarly journals.[122]

As Pouris and Richter summarise, in the late 1970s, appreciating the national strategic importance of original research, the government began to involve itself in assisting scientific and other independent journals that were not aligned to the state in any way. In time, these came to be "dominated by direct and indirect government intervention"[122]. Initial financial support came in 1976 with the establishment of the Bureau for Scientific Publications, a division of the Foundation for Education, Science and Technology within the Department of Education and later within the DACST. Production and marketing were centralised, grants and subventions were paid, and a process of accreditation was instituted to identify quality journals that merited state subsidisation. While the idea might have had merit, it was not a success. The Bureau lacked suitable editorial and management skills which, by the time of the investigation in the late 1990s, had become obvious. There was confusion, inequity, idiosyncratic inclusions, and support for inappropriate journals.[123]

In some respects, the *SAJS* was an outlier in these developments. As Baker recalled in a comment to the author on a draft of this article, this was so because, while recognised by the Bureau, it was not a recipient of government largesse or control directly through this means. Fortunately, while funded principally by DACST, the Journal was transferred (without additional funding) to the Foundation for Research and Development (FRD) through the assistance of Kingwill after the AS&TS collapsed in 1990. Kingwill also organised office space for the Editor at the Foundation for Research and Development by appointing Baker to a special unit of the CSIR where he provided editorial services in kind. Had Kingwill not made these arrangements, it is very likely that the Journal would not have survived.

Rather than limiting circulation among members only, the Journal was published as a subscription-based periodical, which is now the most familiar model. Market-related subscriptions were set, rising annually and often dramatically (e.g. in 1974 the subscription cost was R18 (or US$25), in 1982 R24, in 1987 R44, in 1992 R110, in 2002 R324, and in 2012 R730). In the early 1990s (from Volume 88), rather than 12, 10 issues were published annually. These figures demonstrate the decline of the South African rand as much as the rising cost of the Journal, but it continued to be sought after by authors and subscribers.

It is clear from assertions by Pouris and Richter that the *SAJS* had, by then, become the country's most outstanding journal in every way, and – notably – one of only three with a full-time paid editor. That it attracted the best research in the country can be judged by the fact that in 1993/1994, while South Africa's 48 A-rated scientists published principally in specialist and international journals, there were 14 articles in local Bureau for Scientific Publications journals, of which 11 were in the *SAJS*.[122] The Journal had become the jewel in the crown of South African accredited research journals. As Pouris summarised in 2004, the *SAJS* was climbing up the citation ladder in comparison with other multidisciplinary journals internationally and was among the most highly ranked South African journals.[124]

With Baker as Editor, and with assistance at various times from Bonnie Berger, Susan Jack, Lily Mitchell, Meg Kemp, Lyrr Thurston and Lizél Kleingbiel, the Journal was publishing interdisciplinary material that remains relevant. Contents tackled a variety of current topics like environmental science, palaeoanthropology, technology, research on

biodiversity, mining science, scientometrics, and nuclear physics. Work on HIV/AIDS, Marion Island and the Antarctic featured prominently. Sustainable development, ecotourism, and atmospheric science made their appearance. By contrast, articles on astronomy and physics, once relatively common, were extremely few, as were the social sciences and humanities.

Between 1973 and the mid-1990s, the *SAJS* had thus moved into another phase in its life; it could no longer be considered the mouthpiece of a democratic and varied scientific community that regularly renewed personal ties with one another. Rather, it attracted excellent scientists who saw academic merit and impact of their research from publishing in the Journal.

The *SAJS:* 1994–2002

The year 1994 was decisive in South Africa with the transition to a democratic non-racial constitution, an event as politically and economically momentous as had been the Union of South Africa in 1910. Ending apartheid had an impact on every South African as well as on every state institution. For the *SAJS,* change came with the dismantling of older scientific structures and the formation of their replacements. While he was in exile, anti-apartheid activist Roger Jardine had been Coordinator of Science and Technology for the African National Congress (ANC), the party which was then banned but which was later to govern South Africa. In 1995, with the ANC in power, Jardine was appointed Director-General of the DACST.[125] He restructured the managerial institutions within his large Department and one of the consequences was that journals under the aegis of the Bureau, as well as others that enjoyed state funding, were scrutinised and the Pouris and Richter investigation commissioned.[122]

What was to become of the *SAJS*?

As Baker, who was to continue as Editor until 2008, has explained, each journal then had to seek its own future. For the next decade, the *SAJS* was produced by Isteg Scientific Publications, a small highly skilled company, located in Irene near Pretoria and run by zoologist Nico Dippenaar.[123] This arrangement worked smoothly with Baker's oversight. Other journals were not so fortunate, and many – including the *Transactions of the Royal Society of South Africa* which was also produced by Isteg but without a professional editor – struggled to survive. A few journals were taken up by university presses as part of their publishing portfolio, particularly by Unisa Press, while international publishers eyed South Africa for potentially profitable acquisitions at bargain prices.[123] Indeed, some journals were sold to international buyers.[25] Taylor & Francis, for example, saw an opportunity at this time when it began its Sabinet African Journals initiative. That company now owns or manages almost 20 southern African or African journals, some of which have contracts that allocate profits to these publications or to the scholarly societies involved in them, and very many of the journals in the overall Taylor & Francis stable are discounted to subscribers in Africa.[126]

Even before 1994, however, moves were afoot to provide what was to become the new democracy with an ideologically appropriate science academy. Between 1989 and 1990, a Plan Document was discussed informally in academic circles, a development initiated by the Akademie (perhaps appreciating that its dominance was to be challenged) and facilitated by the Foundation for Research and Development (which itself was to become the National Research Foundation in 1999). The steps taken towards the establishment of what was to become the Academy of Science of South Africa (ASSAf) in 1996 were recalled in the *SAJS* at the end of 2001 by Wieland Gevers, Emeritus Professor of Medical Biochemistry at the University of Cape Town, and President of the Academy from 1998 to 2004. As he described, a group regarding themselves more as "concerned citizens" than scientists, and representing the Akademie, the Royal Society of South Africa and the Science and Engineering Academy of South Africa, together with a number of black scientists (whom Gevers did not name), debated the fundamental question of whether a national Academy was necessary for South Africa and, were it desirable, how it might function.[10,127] One of this group, George Ellis, renowned cosmologist at the University of Cape Town, was particularly encouraging of a new scientific worldview that would be of practical benefit to wider South African society, not only those already privileged, although 'blue skies' research would not be neglected.[96(p.319-327)] It was generally appreciated that South Africa's political isolation would end with democracy and that it would once more be globally connected with the many benefits to knowledge generation that would accrue.

If there was dissension over features of the budding organisation at the time, they are not mentioned in Gevers's article. There he described how various bodies boldly seized the democratic moment to maximise "better prospects than ever before for commonality of purpose among South Africans", while allowing other academies to work with the new Academy "to achieve greater synergies and focus" and together develop democracy. Gevers's article outlined those parts of the Plan Document that pertained to the organisational structure and mission of ASSAf, noting that: "The Academy of Science of South Africa is constituted to ensure that leading scientists, acting in concert and across all disciplines, can promote the advancement of science and technology, can provide effective advice and can facilitate appropriate action in relation to the collective needs, threats, opportunities, and challenges of all South Africans."[127] Some of the language and aspirations conveyed by Gevers resonate with those that informed the founding of the S_2A_3 in 1902, a time of an earlier critical political juncture in the country, as has been explained above. Also in line with the values of the early S_2A_3 was the ASSAf policy that it would not be a solely natural science academy but open also to the humanities and social sciences.

What the Academy introduced was the novel scholarly objective "to apply scientific thinking in the service of society". Operating in a new political environment that required capacitating groups and communities previously disadvantaged through apartheid, the work of the Academy was explicitly developmental and service oriented. The elected membership was to be mobilised to utilise its expertise towards this goal.[128]

With the conception that science needed to be connected to the urgent need for national material development, the government of Nelson Mandela took the decision to establish a new academy of science.[96] Thus, in 1996, ASSAf was inaugurated. Discussions continued while legal issues took time to finalise, but with *Act No. 67 of 2001* (in operation from 2002), the Academy was established in law as the state's sole national academy, replacing the *Akademie* in this role.[129] ASSAf would be overseen by, and funding would be provided by, the responsible Cabinet Minister, but the Academy itself would be independent.[127] This background has been explained because the future of the Journal was to become integrated into the mission of the Academy, indeed it was regarded as one of the means of meeting its objectives.[130] Thus began the next chapter in the life of the *SAJS*.

The 1996 initiative that propelled the establishment of a new national science academy for a changed South Africa was celebrated 20 years later in December 2016 in a special issue of the *SAJS* comprising a number of commemorative articles.[131] (ASSAf also published a book to mark this anniversary.[10]) In his Guest Leader, Gevers – in understandably celebratory tone – recapitulated the five-year period that was led by the planning team and that culminated in the ASSAf Act in 2001 referred to above. The rationale of voluntary contributions from elected ASSAf Members had, it seems, also been decided upon in these first years, as well as the convention of consensus advice and consensus positions (or consensus reviews), on matters of scientific – evidence-based – knowledge.[132] This harked back to the volunteer tradition of the S_2A_3.

It was agreed when the Academy was founded that, because of the high international stature enjoyed by the *SAJS*, indeed it was a "national asset"[96(p.325-327)], the Academy would be its new home[133], and that once the Academy was in receipt of state funding it would be fully subsidised by the taxpayer[133]. As explained by Gevers in 2001, one of the major "goals and measures" of the Academy was "publishing/partnering major science journal(s)"[127]. This meant that a publication team within ASSAf had to be established for the *SAJS,* and Baker, who remained Editor until 2008, was involved in the process. He suggested that editorial positions be advertised among the ASSAf Members to guarantee quality and expertise.[134] In August 2002, shortly after ASSAf's legal foundation and after all Members of ASSAf had been invited to nominate Editorial Board members (or themselves volunteer), the

Academy appointed three Associate Editors to work with Baker while ASSAf organised itself administratively and financially to take over the *SAJS*. They were zoologist Michael Cherry (Stellenbosch University), educationist Jonathan Jansen (University of Pretoria), and physicist Harm Moraal (North West University). The four other members of the first Editorial Board were chemist James Bull (University of Cape Town), Anthony Mbewu (Medical Research Council), archaeologist Judith Sealy (University of Cape Town) and Petro Terblanche (Medical Research Council and University of Pretoria). *SAJS* also boasted a Management Committee, comprising Gevers, Baker and Cherry. Physicist H.J. (Hennie) Smith, who had been employed by the CSIR from 1963 to 1980 and thereafter by the Department of National Education in the office of science policy until 1999, was, as the first Administrator of ASSAf, also a member of the Journal's management team.[135] Matters requiring practical attention at the start of ASSAf's ownership of the *SAJS* were, for example, whether Editorial Board members should solicit articles, and how editorial policy should be determined.[136] After difficulties about the location of the Editor's office had been resolved[137], the Journal began its new, and to date current, institutional affiliation.

Situating the Journal within the Academy heralded its return to a stable institutional base. Its quality, stature, name, and long history worked in its favour and there seems to have been no debate around establishing a new ASSAf journal, perhaps with a title something like the *Proceedings of the National Academy of Sciences* in the USA.[138] In addition, the *SAJS* – at least initially – had been a broad church in terms of the range and quality of articles that were published and in the kind of scientific news it provided. ASSAf intended to adopt the best of both features – the high quality of original work for publication, but also the inclusion of News, Profiles, Book Reviews, and Opinion pieces of a more general nature.

The *SAJS:* 2003–2024

In 2003, Gevers formally announced in the Journal that the Academy would take over ownership and publication, thanking Baker who would remain Editor for the time being. Just as the life of the *SAJS* had been integral to the S_2A_3, so too was the Journal integrated into the birth of ASSAf. During this final period of Baker's editorship, special interdisciplinary collections of articles were commissioned that highlighted subjects such as HIV/AIDS research in South Africa (2000), a century of science at Rhodes University (2004), Working for Water (2004), Sibudu Cave (2004), the coelacanth *Latimeria chalumnae* (2005), and the CSIR at 60 (2006). They, and others, remain important synthesis studies on important aspects of South African science. In this period too, with President Thabo Mbeki's ideas on an African Renaissance[139], and the restructuring of South Africa's universities in 2002 by then Minister of Education Kader Asmal[140], black authorship in the *SAJS* increased (although no racial statistics have been maintained) as universities transformed racially and research funds for early-career black scholars became available.

Graham Baker retired in 2008 and in his final Leader he recalled a few of the highlight articles that the Journal had published in his time. He, naturally, also made mention of the ISI listing which came within the first decade of his editorship.[120] Over almost four decades, he gave the *SAJS* its modern voice and its reputation, setting it on a successful journey in what were very difficult years in South Africa.

From 2009, the *SAJS* had a new look under new management and, for the first time, dedicated paid staff and technical service providers ensured regular and quality production and distribution. It should also be mentioned that, as the S_2A_3 had done for the visits of the BAAS in the 20th century, ASSAf hosted the Academy of Sciences for the Developing World (TWAS) in 2009. The theme of this visit was also not unlike that for the BAAS visits, which was to give South Africa the opportunity to profile local science. A celebratory book, also similar to those of the S_2A_3, was published to mark the event.[141]

This article is not the place to provide an account of the short history of ASSAf, any more than it is to do so for the S_2A_3. In time, when greater perspective is possible and when what are now sensitive documents that detail the twists and turns of debates within the Academy and its Journal, and of its relationship with the state, are made publicly available, critically investigating the many personae of ASSAf and its subsidiary institutions, like the *SAJS*, will be worthy of historical attention. The objective here, though, is to focus on the *SAJS* and ASSAf in its role of publisher and owner.

With the acquisition of South Africa's most prestigious and well-known journal title, the *South African Journal of Science*, ASSAf was in a strong position to maximise its objective in terms of involvement in scholarly journals and scholarly publications in the country more generally. Perhaps one might even argue that the *SAJS* shaped the formation of ASSAf's Scholarly Publishing Unit by providing an example of excellence in all respects. For ASSAf was now the owner of the longest-existing and most highly cited South African multidisciplinary journal with wide international recognition. ASSAf's head start in scholarly journal publishing was thus unassailable and the Academy embraced its leading role enthusiastically. In his final Leader, Baker had summarised the success of any journal as teamwork, attention to detail, hands-on specialist publishing skills, and competent management.[123] With the large resources of the state at its disposal, ASSAf was able to meet all four criteria.

In fact, it was able to do more. Over the past 20 years, ASSAf has maximised ownership of this flagship journal to leverage, enhance, develop, and support academic publishing in South Africa. Without the example of its own pre-eminence in the field as a catalyst, ASSAf may well have taken much longer to establish itself as a fulcrum of scholarly publishing. While the time is not yet ripe to evaluate critically those initiatives in the longer run, they are worth mentioning.

Before Baker's editorship of the Journal ended, two important decisions were taken. The first was to establish the Scholarly Publishing Unit within ASSAf – effectively replacing the old Bureau. However, careful research had been conducted on what such a unit might comprise and accomplish. It began life in 2006 after a consensus report entitled *Strategic Approach to Research Publishing in South Africa* had been completed during the ASSAf Presidency of Robin Crewe, an entomologist and then Vice-Principal of Research and Postgraduate Studies at the University of Pretoria.[142] (A second report on this subject was published in 2018.[143]) Baker commented favourably on the broad recommendations of the first *Strategic Report* but was disappointed at "scant mentions of the realities with which the country's journals have to grapple"[123]. Nonetheless, with the Scholarly Publishing Unit in place, a start could be made on establishing the Scholarly Publishing Programme at ASSAf.[144]

It is not the intention here to give a history of all the initiatives within this Programme, but it has been suggested that, for the benefit of readers of the *SAJS* who might be unfamiliar with the workings of ASSAf and its contributions to scholarly publishing, mention should be made of some of the most important.[145] The overall point to be made, however, is that without the quality and strength of the *SAJS* from the outset as an example, the wide range of publishing tools, committees, and expertise would have taken far longer for ASSAf to establish.

The Journal itself was to continue to be multidisciplinary, publishing only original work, but specifically – as part of ASSAf – to include the humanities and social sciences which had tailed off under Baker with the foregrounding of the natural sciences. Contributions also had to be of reasonably short length, written in an accessible style, and be of interest to a variety of readers. In line with government priorities to liaise with academies in Africa, the focus was to shift from South Africa to include science on the African continent and the *SAJS* would welcome submissions from Africa or on Africa-focused research. A magazine element would be included in a 'front section' that allowed for debate around research, higher education, and other matters relevant to southern African scientific life.[146]

Baker was not replaced by another full-time salaried editor and ASSAf reverted to a more committee-like structure for the Journal, as had been the situation until the early 1970s. Michael Cherry, then contributing African correspondent for *Nature* and an Associate Editor, was employed as part-time Editor-in-Chief with a term of office that ended in 2012. At the time, Linda Fick joined as full-time Editorial Assistant, later to become Managing Editor, a position she has retained. Ten part-time Associate Editors from different universities in South Africa have been responsible for overseeing manuscripts through peer review and acceptance for certain clusters of disciplines, rather like the Section Committees had

done in bygone years.[147] With the appointment of Editors-in-Chief John Butler-Adam (2013–2019), Jane Carruthers (2019–2021) and currently, Leslie Swartz (2021–), this model has continued.

Technological advances in publication have brought drastic changes to the production of the Journal. Noting in 2000 that "the world of scientific publishing is in turmoil"[122], Pouris and Richter had identified numerous future scenarios that would confront scientific journals. Of them, changing technology is perhaps the most critical. From 2002 onwards, ASSAf began investigating online publishing.[135] The era of print-only journals was being threatened by the Internet, demands for open access, and technical advances in electronic publishing. In this regard, the Journal needed modernisation and, in the long term, it was anticipated that this would be financially favourable. Printed copies were phased out, terminating at the end of 2015, subscriptions were ended, and the Journal is available without charge online.[148] South Africa is fortunate to circulate good research in a journal that is freely available to both authors and readers – a rare luxury anywhere in the world.

Baker's commitment to public outreach chimed with that of ASSAf, and his proposal was accepted by the Academy – with financial support from government – to publish a well-illustrated and colourful quarterly popular science magazine. This would be a non-peer-reviewed partner to the *SAJS* and entitled *Quest: Science for South Africa*.[33] Like the *SAJS, Quest* is distributed online free of charge, but printed copies can be mailed to paid-up subscribers.[149]

In 2009, the *SAJS* became one of the first journals in South Africa to become fully open access, one of the vital advances in modern scholarly publishing. In 2012, the Journal was the first to be uploaded onto the SciELO SA online platform. SciELO (Scientific Electronic Library Online) is a cooperative publishing electronic model for open access journals that was established in Brazil in 1997 and specifically designed for developing countries. ASSAf facilitates South African scholarly journals in joining this platform and currently there are more than 100 on the local list.[150]

Linked to the SciELO initiative are ASSAf's Khulisa Journals – all of them on the SciELO platform hosted by ASSAf while maintaining their independence. Khulisa (which means 'to grow or nurture' in Zulu) is a federated platform which enables this group of journals to take advantage of training, improvements in technology, content management systems, and access to professional editorial assistance from ASSAf and the team at *SAJS*.[151] At present there are almost 20 journals in the Khulisa group.[151]

Further journal publishing services offered by ASSAf are the regular peer review of groups of academic journals arranged by disciplines.[152] This process (which can sometimes be slow as it relies on volunteer reviewers) controls quality and monitors Editorial Boards, peer reviewing processes, and other aspects relating to scholarship and journal management and publication. ASSAf has also published *Guidelines for Editing and Peer Review* that established the high standards to which scholarly journals in South Africa are required to adhere.[153] In addition, a Committee on Scholarly Publishing in South Africa has been created to deal with matters as they arise.[154]

From this list of activities, reports, initiatives, and long-term commitments offered by ASSAf, it will be evident that the *SAJS* has evolved over more than a century from a volunteer-run scientific periodical reporting on personal interactions and papers read at convivial meetings into one, and vital, component within ASSAf as part of its substantial government-supported bureaucracy. And within this vortex of activity, the *SAJS* has maintained its high stature, the quality of its published articles, and the relevance of its news and opinions in the front section. Suffice it to say, that after the takeover by ASSAf, with paid technical and managerial staff as well as part-time Associate Editors responsible for different sets of disciplines, plus access to up-to-date production technology, the *SAJS* has become the kind of journal familiar to academics around the world. The website is clear on electronic submission requirements, double-anonymous peer review, tight editing guidelines, word limits, and a defined reference style.[146] As is explored elsewhere in this special issue, the Journal is not short of submitted manuscripts and the website records a rejection rate of 95% in 2023, primarily because aspirant authors, often desperate for a publication outlet to enhance their careers (and without payment for publication), generally do not appreciate that the *SAJS* is specific in its mission to provide high-quality articles, written for a non-specialist readership, that must focus on South Africa or Africa in terms of interest or relevance. The Journal has a high citation rate and impact factor, as is also explained elsewhere in this issue.

Conclusion

Biographical simile has been used to explain the changing 'life' of the *SAJS* over the 120 volumes that have been published since its birth in 1903. This approach has enabled a focus on the Journal itself as an actor in South Africa's history of science communication and, indeed, science itself. Like any life, it has ebbed and flowed with historical and institutional constraints and opportunities. It has aged, matured, changed direction, met difficulties successfully, or succumbed to some of them. But, of course, that life has not ended, and the history is incomplete. Throughout these many decades of publication, the Journal required reimagining by institutions and individuals to survive the challenges of passing time and changing contexts. It also required editorial and managerial nurturing to enable it to grow and develop and adapt, not always easily, to change. It has also needed passionate scientists in very many fields to contribute their research to it and thus enable the Journal to attain its scholarly maturity. It has been fortunate to have found supporters, protectors, advocates, and contributors over a very long period of time, and this in a country renowned for extreme social and cultural diversity and political division.

Changes in methods of disseminating scholarly research over the last 20 years have been rapid. As Baldwin describes, "the growth of online publishing has placed scientific communication in a moment of transition not unlike the moment in the nineteenth century when the scientific journal rose as the dominant form of communication"[14(p.238)]. But the academic journal has not merely moved to a different platform, it is undergoing comprehensive radical transformation. How the *SAJS* responds, for example, to open peer review, different scientific paradigms (indigenous knowledge), artificial intelligence, or the power and immediacy of social media, among other innovations that may pose a threat to evidence-based science, has still to be seen. Currently, it has the advantage of being situated within a recognised academy of science and funded by the South African fiscus. It is entirely possible that in the future, under different circumstances, these may not remain the strengths that they presently are. As Fyfe et al. have stated, "a better understanding of the history, rather than the myth, of scientific journals is crucial to help us decide which practices and functions should be included in any new vision for academic publishing"[17(p.605)].

The overall life of the *SAJS* may be summarised by its resilience, its adaptability, and its excellence in different ways at different times, and it has persisted through one of the most momentous centuries in recent human history.

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Data availability

There are no data pertaining to this article.

Declarations

There are no competing interests to declare. I have no AI or LLM use to declare.

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Some reflections on the *SAJS* – an unbroken thread in our national life since 1905

Significance:

A scholarly journal that is national in its base and truly multidisciplinary in its scope is a key instrument for bridging not only the divides between disciplines but also those between policymakers and policy implementers, on the one hand, and scientists and scholars, on the other. The *South African Journal of Science* has achieved this in different ways during its 120-year history, and is set to continue to play an essential role in the future.

The *South African Journal of Science* (*SAJS*) has made available for 120 years – through continuous publication, distribution and accessible library storage and access – many of the big ideas of a host of South African scholars from many disciplines, always recorded in words that have been carefully chosen to convey meaning both to a broad range of academic readers and to the public at large. In each case, those words have supplied the evidence and/or the argument for the ideas put forward: the essence of 'Science'. The format and publication mode has not always been the same through this long history, as will be described below, but the basic intention of multidisciplinarity, excellence and relevance (local and more broadly) has been constant.

I have had an association with the *SAJS* for over 50 years. First, it was as an author who contributed research papers that I thought were of interest to a wider audience than was the usual case. Later I wrote many articles for the 'front section', after negotiating the transfer of the Journal to the Academy of Science of South Africa (ASSAf) while chairing the ASSAf consensus panel on scholarly publishing in South Africa, and becoming, for a while, the Chair of the SAJS Editorial Board. The pieces I wrote had mostly to do with ASSAf reports and other activities, including a Presidential Lecture in 2003[1] on why ASSAf is an academy of 'Science' and not of 'Sciences'. There was also a guest leader on ASSAf's 20th anniversary in 2016.[2] I had a further spell as an Associate Editor for medical/health papers, and most recently I have supplied a number of book reviews. You could say the *SAJS* is in my blood. Why?

The first reason is that every scientist, anywhere, and especially one who teaches at both under- and postgraduate levels, needs to cover both the deep science of the research projects currently under way, as well as the highlights of progress in the entire discipline concerned, and even other disciplines. This is for the maintenance and indeed continuing expansion of both specialised and generally contextual academic authority. Using automated services prompted by key words launched into the cybersphere usually ends in a narrowing of perspective, and reduction of the ability to perform what is loosely called disruptive science, where germs of new ideas in one discipline or field are often creatively stimulated in another by reading 'outside the box'. A better solution in my experience is to choose a limited set of journals, regular informed scanning of which will give a sense of active control to the 'keeping up with the literature' process, and allow a secondary back-up system to be designed to catch 'the pearls' that may appear from time to time in journals outside of the favoured set.

An important elaboration of this kind of balanced reading practice can be found in the prominent role that the two leading international multidisciplinary journals, *Nature* and *Science,* play in the daily lives of the majority of working scientists worldwide. They are designed selectively to attract articles of great actual or potential significance in many fields, which are published quickly in weekly issues, each with abstracts that summarise their message in comprehensible language, plus frequent 'News and Views' perspectives on the significance of the new findings and ideas behind them. The full articles are there to digest when interest is sparked. Few discoveries of real importance in any field outside of the humanities will escape appearing in this convenient and readily digestible form. A number of other journals play similar if much lesser and more regional roles. In 2005, it was shown in a purely bibliometric study that the *SAJS* ranked 14th amongst these kinds of journals in the world, ahead of every other developing country[3], the result of three decades of effort mainly by Dr Graham Baker, a new full-time editor who had been assigned by the editor and chair of *Nature* to convert a then languishing publication into a regional version of itself[4]. For a scientist working in South Africa, it becomes a very sensible thing to add the *SAJS* to the two international leaders on one's regular reading list to ensure that one keeps up with key developments in the country where one is working. The *SAJS* strives to offer exactly what this recommendation presupposes – content that is maximally useful to two categories of its most crucial readership, working scientists, scholars and students, on the one hand, and policymakers at various senior levels, on the other (as elaborated further below). And this would be the case particularly within and for this country, but also for possible use by many other African countries.

There are two determinants of what appears in the *SAJS* at the present time: the authors who decide to submit their manuscripts to this rather than to another journal (and who may be enticed to do so by a well-publicised journal policy), and the editors' discretion in deciding to publish a paper supported by the independent referees concerned, in the (very likely) event that there are more submitted papers that are thus supported than there is room for in the Journal's present bi-monthly digital space allocation. The 'regional go-to multidisciplinary journal' model would predicate a 'front section' of editorials, selective book reviews and obituaries, summaries of ASSAf consensus and forum reports (which I might add have been lacking lately) and public statements, and 'commentaries' of a particular kind (see below). The 'back section' would comprise peer-reviewed research letters, articles and highly selective reviews, all with crystal-clear abstracts, and all reporting new work that is of interest beyond a narrow circle, ideally a solid study in one discipline that has obvious resonance in others, or a study that successfully combines the perspectives and methodologies of more than one discipline.

Producing the above content in the *SAJS* ensures that it retains its significant place in South Africa's science/knowledge system, and caters for the one large category of its readership already mentioned – the scientists and scholars and their graduate students, etc. But what about the other category also mentioned – the policymakers, at various senior levels?

Like the two international leaders, *Science* and *Nature*, the *SAJS* also seeks to bring scientific insight to those who have control of the state resources to develop the nation in all its facets. Unlike the two leading journals, however, the *SAJS* is published by a national science academy. When ASSAf was formed in 1996, it resolved to use the combined and considerable multidisciplinary strength of its Membership primarily for the benefit and advancement of society, meaning the people of this nation – 'Science for Society'. It has developed a number of modalities to achieve this goal, ranging from major 'consensus studies' conducted by multidisciplinary panels generating policy advice by focusing on already existing evidence, to convened forums doing the same thing but in a shorter time frame, and regular or ad hoc commissioned policy papers or public statements. This approach creates an additional role for the *SAJS* as an ASSAf publication – publishing evidence-based, authoritative material that can and should influence public policy. The Academy has already made many improvements in the editing, management, and distribution of the Journal, including sending out thousands of notices about the contents and import of new issues, many reaching precisely the kinds of policymakers who can benefit from them in their areas of responsibility. These innovations in relation to the *SAJS* have been ably summarised by my successor as Executive Officer of ASSAf, Roseanne Diab.[5] But there are more tales to tell.

I was long aware that the Journal had originally (from 1905 to 1949) been quite a different animal from what it is today. It was first published by a newly established local body then called the 'South African Association for the Advancement of Science', colloquially shortened to S_2A_3, during a period of intense discussion and planning activity involving the still-separate but adjacent four British colonies recovering from the devastation of the Anglo-Boer War. [In many ways this resembled the multiple planning forums of the early 1990s before the democratic transition in South Africa.] The annual meetings of the S_2A_3 continued after the Union and were held in various cities. They mainly comprised invited lectures by prominent scientists and scientifically literate public servants, administrators, engineers and industrialists. Manuscripts of the presentations at each meeting were edited and published in one annual volume of the *SAJS*. The S_2A_3 soon developed 'Sections' to cater for more discipline-specific material, some of it representing articles presenting original research, but always published the broad-based but highly authoritative 'presidential lectures' of each section and that of the overall S_2A_3 president.

I have taken the trouble (over some months) to go through all the since-digitised issues of this kind that were published between 1905 and the present. [I must admit that I was prompted to do this by my careful scrutiny of Beinart and Dubow's magisterial book entitled *The Scientific Imagination in South Africa*[6] which I had the privilege of reviewing for the *SAJS*[7], and which referred frequently to papers published in the *SAJS* at various times and in various contexts.] I can honestly say that it was a journey worth taking. As somebody who has spent most of his working life as a scientist but was fortunate enough to be initially schooled by great scientists who were acutely aware of the history of ideas, I could see a great tapestry of exploratory endeavour with a constant developmental focus for a young country. What is more, that focus was clearly much more inclusive of the whole population than I had anticipated, taking into account the major background issues of historical colonial expansion and the subsequent consolidation of a white industrialised 'nationhood' in most of the country requiring the labour of its other people but granting them no rights. A number of articles addressed such issues in a variety of ways, but by far the majority of the lecture-articles represented the sorts of unbiased and inclusive expert reviews of soil quality, insect control, mining technology, natural resources, skills development, transport, etc. that any government would have been very pleased to have at its disposal. Many of the civil servants featured as published lecturers, including one prime minister, several ministers, and many heads of state entities and institutions, were clearly able to hold their own intellectually with the scientific elite of the country.

It was interesting to find that another watershed in the country's history, World War II, also featured a peak of planning and re-organisation, shown by a published symposium in 1942 on 'thinking ahead for the postwar period'. This began in Volume 39 of the *SAJS* with a double act by the giants behind then prime minister Smuts's state-led industrial-based development (Eskom, Iscor, the Industrlal Development Corporation, CSIR, etc.), Drs HJ van der Bijl and HJ van Eck, both with extremely impressive academic credentials. Their concise but highly significant papers were forward-looking, remarkably liberal politically (for their time), and authoritative in a way that signified clarity of vision and confidence.[8,9] The then Liberal Party's Margaret Ballinger weighed in with views on social upliftment and widening political rights that did not seem at odds with the mood of the symposium.[10] Finally, Minister JH Hofmeyr, also a considerable intellectual, summarised the consensus views and mood of the meeting and added his own angles on many aspects.[11] Good things may sometimes come from great disasters, but the country's political history most unfortunately took a different course in this case, despite maintaining the strong industrial momentum for decades in the ways so well chronicled by Beinart and Dubow. The main point to be made here is that these speakers were addressing a gathering of scientists and scholars, and that the context was one of spreading the powerful developmental notion of a "commonwealth of knowledge", the heading of one of Beinart and Dubow's chapters relating to this time. It is clear from the record in the *SAJS* articles that the link between the then government and the scholarly community, defined as including highly qualified applied-science practitioners as well as full-time academics or researchers, was very close and direct at that time.

A particularly cogent example of this kind of 'consilience' (the word coined by Edward O. Wilson to signify the essential unity of all knowledge despite the need to address particular classes of problems with structured 'disciplines'[12]) is the presidential lecture given in 1934 by the remarkable geologist Alex. L du Toit.[13] He was then the main authority on South African geology ('The Geology of South Africa', 1926[14]), including applied aspects relating, for example, to mining, and contributed decisively to our modern conceptual understanding of continental drift through his detailed comparison of strata and many other features in South America, Australia and Africa ('The Wandering Continents', 1937[15]), which topic was the subject of another significant article in the *SAJS*.[16] The aforementioned presidential lecture was entitled 'Some Considerations upon Agriculture and Mining in South Africa' and dealt in great depth with the implications of the underlying geological formations and ongoing processes on what were then the two principal economic drivers of the country. Du Toit's grasp of matters not strictly in his own domain was staggering (he had obviously taken good advice from trusted colleagues) – climate, geography, water resourcing, crop growth, stock farming and economics in the case of agriculture, and prospecting, mining technology, markets and costs in that of mining – all were dealt with in a comprehensive fashion but always in relation to what the author really knew about, namely the earth under our national feet, so to speak. Much of the news was not good, but solutions were proposed.

There are many other examples of outstanding scientists and scholars providing contemporary 'master classes' of this kind, recorded forever in the pages of the *SAJS* in its first half-century. [They differ from the modern 'review article' which is usually a summary and synthesis of a sub-field of a discipline, and may have little to interest or teach people from outside the sub-field concerned.] Because the papers started life in each case as a lecture in the context of an audience intensely committed to the development of a young country, the lecturers/authors usually strongly contextualised their presentations/articles in precisely the way Du Toit did in his 1934 presidential lecture on agriculture and mining in relation to local geology. The question arises as to whether present-day Alex du Toits can still find an opportunity to submit and publish such papers, *and* have them be taken seriously by policymakers? Present-day South Africa has a much more diverse set of organisations and entities that offer public lectures at various times of the year, such as the National

Science and Technology Forum; the National Research Foundation; the Council for Scientific and Industrial Research; the Human Sciences Research Council; the residual S_2A_3 functioning mainly in Gauteng; we have two sectoral academies, the Royal Society of South Africa and the Suid-Afrikaanse Akademie vir Wetenskap en Kuns; an Academy of Engineering of South Africa; and our inclusive national science academy, ASSAf, the only one with a well-developed multidisciplinary journal which is the *SAJS*. Cooperation amongst several or all of these bodies could in principle resurrect a single annual conference, or a family of authoritatively convened and coordinated public lectures that could serve to generate the kinds of powerfully insightful and persuasive lecture-publications of the glory days of the S_2A_3 and the *SAJS*… but is it actually necessary?

The editors of the *SAJS* over the last 50 years, assisted more recently by associate editors to broaden the catchment for valuable submissions, have made every effort to garner and publish potentially policy-influencing science, and my perusal of all the issues in this period has confirmed a steady trend to the kinds of papers that do precisely what those published in the first half-century of S_2A_3 annual conferences did – papers with an intense focus on national development and its promotion through the application of scholarly and scientific thinking. Most welcome is the inclusion in a seamless manner of many papers of this type from the humanities and social sciences. Authors are essentially self-convening themselves into contributing papers that build a 'commonwealth of knowledge'. I was actually astonished to note the extent to which the goal has been achieved of making sure that a regional 'must-read' multidisciplinary journal also plays a vital national role of bringing solutions to the table that are supported by evidence and backed by scholarly authority. The Academy as publisher of the *SAJS* thus makes a major bottom-up contribution to policymaking, in addition to its other modes of generating reliable advice on national problems impeding the building of a good future for *all* the country's citizens.

Declarations

There are no competing interests to declare. There is no AI or LLM use to declare.

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Editorial reminiscences on the occasion of the *SAJS* 120th anniversary (1973–2008)

It would be fair to claim that the present era of the Journal's operation – the last half century – began in October 1970 with preliminary negotiations between John (later Sir John) Maddox, then editor of *Nature* in London, and Denys Kingwill, director of Information and Research Services at the CSIR. South Africa's international reputation politically had reached an especially low ebb, but Kingwill had the insight and resolve to invite someone with unusual international clout to see for himself how South Africa's widespread and growing academic boycotts might be addressed. So Maddox, at his own expense, came and visited selected universities, as well as the CSIR, to gauge academic attitudes to the politics of the day. He concluded that research scientists in particular should be supported because he considered that, in the main, they were a force for good and would be needed if the country ever threw off its apartheid legislation to become a democracy. He made these thoughts public in an editorial he wrote on his return to London, entitled 'Science is a Trojan horse'.[1]

Maddox had just been appointed managing director of Macmillan Journals Ltd, a position he relished as a man who responded with exceptional enthusiasm and energy to publishing challenges. The *South African Journal of Science* (*SAJS*) became one of them.

Kingwill had a second reason for inviting Maddox. He had long wanted the *SAJS* to play a more prominent role in reporting the science conducted in the country. By the early 1970s, however, the Journal had almost run out of both its traditional support and multidisciplinary manuscripts – membership of its founding organisation, the South African Association for the Advancement of Science (S_2A_3), was declining with the steady growth of specialist professional societies – hence his hope that an association with *Nature*, then published by Macmillan Journals, might be able to revive it.

Maddox agreed to lend a hand – which meant funding to pay for an editor and editorial assistant – for a limited period. He told me, though, as a member of his London staff (who were generally opposed to the initiative), that he feared he was "going to lose all my friends" by supporting a South African periodical. Nonetheless, he despatched me to Johannesburg in 1972 to tackle "the South African job", in the belief that the Journal was still a going concern and needed just temporary intervention, working with a local editor and a more robust editorial policy, to become a "South African *Nature*". In fact, the *SAJS* had not appeared for some months, had just three articles in hand, and effectively no staff. As it turned out, it took almost 35 years to appoint that 'local editor'.

The notes that follow sketch some of the Journal's peripatetic experiences in my time as editor, which are unlikely otherwise to appear in the record. A more formal and comprehensive account is provided by Jane Carruthers' review of the history of the *SAJS* in this special issue.[2]

From pillar to post

Within two years of my arrival in 1972, Macmillan Journals announced its withdrawal of funding for the *SAJS* – understandably, as the Journal was losing money, providing no editorial support for the various Macmillan journals in its stable as had initially been a possibility, and Maddox had (temporarily, for five years) left the editorship of *Nature*. That posed two dilemmas whose consequences muddied the waters for two decades: how to fund the editorial staff, and who would assume formal responsibility as publisher of the *SAJS*. For the next 30-odd years I subsisted on a series of short-term contracts with various organisations that served as 'acting' publishers, and the Journal and I moved office no fewer than ten times – lock, stock and barrel, with the historical archive and my store of print files and subscription lists on metal plates (initially), before computers and the cloud made such events less of a burden.

It was again Kingwill who acted to allow the Journal to survive the initial financial setback. As one of the very first employees appointed by the CSIR following its establishment after World War II, he was a consummate diplomat who, in a disarmingly low-key way and with a wicked sense of humour that made dealing with him such a pleasure, could accommodate the scientific politics of the day in what he saw as the long-term national interest. He knew that the *SAJS* had its influential opponents, as I soon discovered, and therefore that the Journal "would always need a champion" – a role he was prepared to assume from the moment I arrived. But the way ahead was not obvious.

Macmillan's early generous funding for the Journal was meant to keep us going until the necessary local support was forthcoming, if the locals wanted it to continue. And some did. Initially, the Johannesburg-based Associated Scientific and Technical Societies of South Africa (AS&TS) housed and took on the Journal at their headquarters in Kelvin House (later demolished) in Hollard Street, which prompted us to establish a dedicated typesetting operation that greatly facilitated the Journal's printing requirements and those of some of the professional societies in the building. The CSIR even set up their Science Editing Unit to support the editor, in exchange for publishing services. That relatively stable situation lasted until 1990 – the Journal meanwhile managed steadily to attract just enough subscriptions and publishable manuscripts to keep us in business – when the AS&TS vacated Kelvin House, moved to a new campus and underwent radical restructuring. The *SAJS* (reluctantly) was obliged to do the same.

The consequence was to start again with a completely new operation at the Foundation for Research Development (FRD) in Pretoria. As the principal source of research funding in the country, this was an obvious location for the editor, even though some members of the FRD's otherwise supportive executive were less than comfortable with

the arrangement. It gave me unequalled access to leading researchers in South Africa, and the Journal was able to broaden its reach.

Alas, this generally satisfactory circumstance did not last, because, in 1994, the *SAJS* was again obliged to move offices, this time to the Didacta Building in downtown Pretoria, where the Bureau for Scientific Publications (home of a suite of research journals) had its base at the Foundation for Education, Science and Technology. As had been anticipated even before the move, this relocation proved wholly unsuitable – in part because of a management that was antagonistic to the Journal from the start. It represented relics of traditional authoritarianism adopted by a boss with no professional knowledge of academic publishing, who, among other offences, bizarrely disciplined me for using the *SAJS* letterhead and surreptitiously arranged the destruction of a large part of the Journal's archive. Happily, three years later, in 1997, thanks to the direct intervention of the Department of Arts, Culture, Science and Technology, the *SAJS* was able to return to the FRD (which later became the National Research Foundation).

In 2003, the Academy of Science of South Africa (ASSAf) took over as *SAJS* publisher at the instigation of its president, Professor Wieland Gevers. To avoid a return to the misery of the Didacta Building where the Academy had then established itself, I was able to move to the campus of the University of Pretoria on the generous intervention of the rector. (I had previously declined opportunities to move to a university campus, to avoid accusations of possible partisanship.) There followed a happy and productive time – for me as an editor – in a stimulating academic setting. It came to an end when, once again and finally, I was rehoused, this time at the Academy's new offices in the recently opened Department of Science and Technology building.

New trajectories

During my early days with the *SAJS* in the mid-1970s, there were clearly pockets of good will towards the Journal, yet many leading researchers told me they "would never support it" if their work could be accepted by the better journals abroad. I was afforded the advice of a three-person team for an initial impression of what I had taken on – Professors Phillip Tobias and Nancy van Schaik, of the University of the Witwatersrand (Wits), who shared their knowledge of the academic landscape, and Enid du Plessis, on Kingwill's staff at the CSIR, who "seemed to know everyone" and could interpret South African cultural mores to a complete outsider like myself. A small group of faithful contributors – notably from Wits and the University of Cape Town – were dominant; the formerly Afrikaans-medium universities were largely absent; and the historically black universities were nowhere represented in its pages. That had to change.

The initial promotion of the 'new look' *SAJS* depended on mailings to members of S_2A_3 – who were frustratingly but understandably slow to respond (a common reaction was along the lines of "your ambition is admirable, and we will support you when you succeed" but not until then). The Journal's objective was to open wider a global window onto South Africa's scientific landscape, and to complement some long-established specialist South African journals – which included fields serving geology, chemistry, zoology, mining, and medicine – but not to substitute for them. We also offered a platform to serve disciplines which South African journals lacked. As time went by, we extended special attention to topics in which southern African research was growing and excelling, notably in animal research, the environmental, health and atmospheric sciences, the southern skies, science policymaking and the rapidly expanding fields of microbiology.

Naturally, the Journal's principal focus had to be on trying to attract unsolicited reports of traditional empirical research and reviews, subject to the usual refereeing processes. Initially, that proved a relatively slow and inefficient means of securing a balance of contributions that reflected good research from the desired diversity of representative institutions. So, in the years that followed, another way to attract such articles in areas where South African research was making notable headway, was by accepting News and Views contributions, based on good papers by South African authors that had appeared in leading journals elsewhere (original research articles were, of course, never directly solicited). Another route was to invite submissions to multidisciplinary theme issues, which produced papers on topics that would have been unlikely to feature otherwise.

These strategies brought to the *SAJS* a broad range of material – from South Africa and increasingly from abroad – on emerging subjects such as HIV and AIDS research, southern African biodiversity and materials science, palaeoanthropology, palaeontology and archaeology, even engineering, as well as the occasional festschrift. Contributions came not only from universities but also from our main research institutions, such as the South African Institute for Medical Research and the research councils (including the CSIR and MRC). In the 1980s, two 'anniversary' issues, for the University of Natal (now the University of KwaZulu-Natal) and Potchefstroom University (now North-West University), were followed by sets of selected abstracts from the annual proceedings of professional societies, and conference papers on topics of broader appeal. Some researchers who later became eminent heads of leading institutions would claim to have published their first paper in the *SAJS* – and one article, which was worked on over several months, directly contributed to the author securing a professorship at Yale. South Africa's important archaeological sites became a niche area – and among the world-renowned discoveries at Sterkfontein was the first announcement in the *SAJS* of Little Foot in 1998[3], the year after our series of articles to commemorate the 50th anniversary of the discovery of 'Mrs Ples'.

A common dilemma for any editor is how to assess reviewers' reports. When they all agree, all is well (usually). At times, when they didn't, I wondered if they had read the same manuscript. And what happens when an unusual submission (that could be a pioneering paper) is, predictably, rejected by eminent scholars because "even the basic textbooks make it clear that cells don't behave that way" … and yet, a visit to the lab, as in this case, seems to demonstrate the opposite? Sticking my neck out and publishing that preliminary announcement was a risk, but what reward when, a couple of years later, the first international conference devoted to this new direction helped to rewrite the textbooks.

Another kind of dilemma was whether to accept articles on research that we judged as deserving to be in the public record but which, for whatever reason, might not be readily cited. We decided that our role included this kind of archive, even though it might make little contribution to the all-important impact factors with which funding bodies were becoming obsessed. Nevertheless, by the time of its centenary in 2004, the *SAJS* was ranked eighth out of the 19 multidisciplinary science journals worldwide listed at the time by the Institute for Scientific Information (ISI) in terms of citations.

Helping to raise the profile of the Journal (and get it more eagerly read) were no fewer than three unusually quirky regular columns that featured personal takes – by academics who went on to high positions – on aspects of psychology and physiology as well as exercises in satire ("Ioca Seria", subsequently turned into a book published by Elsevier). I am proud to this day that we found space for such delights.

Housekeeping and its rewards

Many submissions to the *SAJS* needed substantial editing, a process that continued throughout my time. Many (initially most) institutions with a weak research culture could be induced to submit papers in the knowledge that their authors would receive a sympathetic, albeit relatively heavy edit and critical review. That had the benefit of better-written, follow-up contributions. It helped, too, that, at a relatively early stage, the *SAJS* was the only multidisciplinary Journal in the natural sciences produced in Africa – and indeed in the Southern Hemisphere – that was indexed by the ISI.

Undoubtedly, the single national policy that had the greatest effect on spurring our researchers to write for a South African journal was the introduction, in the mid-1980s, of government subsidy for research articles published in a select list of journals. The practice has become well established today as an essential source of university funding, but initially it was not without controversy – for example, which journals would qualify for 'accreditation'? And what kind of article should merit subsidy?

Money matters

A recurring problem was how to fund the Journal and its operations after Macmillan withdrew as publisher. Initially, London had picked up the tab for the shortfall – for printing, postal distribution and the salary of the editor and editorial assistant – from the dwindling income from S2A3 and other subscriptions. The move to AS&TS helped to secure for the Journal a vital government subsidy, which continues in one form or another to this day. For many years, however, a sustainable business model was the subject of much debate. One early suggestion was to emulate the Australian model, in which a suite of national research journals was managed by the CSIRO – a proposal, however, that the South African CSIR quickly rejected.

Somehow, throughout my time as editor, external funding was never enough to cover more than basic services, and I was under persistent pressure to show that the Journal "could eventually pay its way". This was attempted – not by page charges in my time, which I considered discriminatory against researchers at poor institutions – by seeking modest amounts of paid advertising, and subsidy from conference organisers for the publication of their proceedings. But fundraising and stretching the available budget as far as it would go was part of the *SAJS* editor's job and my way of life.

Broader support

Over the years, the *SAJS* office provided various editorial and publishing services to other parties with which it was associated geographically, including the AS&TS societies. For example, we produced a series of technical monographs for the South (today Southern) African Institute of Mining and Metallurgy. Most rewarding, perhaps, was our assistance with the launch and initial support for four years of the Academy's magazine, *Quest: Science for South Africa*, designed to bring to wide public attention the best of the country's science. A primary focus was to use the Journal's published articles as a foundation and its network of authors as guides to the latest and most important South African research, presented to great effect by the founding editor, Dr Elisabeth Lickindorf. The magazine appealed – we were gratified to learn – to readers ranging from learners in their early teens to eminent senior scientists in their retirement.

Those without whom . . .

Inevitably over such an extended period, many people contributed talent and time to the Journal's progress, and space permits me to name only a few. It is my pleasure to acknowledge the editorial assistants who helped to record manuscripts, maintain subscription lists, and negotiate with reviewers and authors (not always an easy task) – Bonnie Berger, Susan Jack, Vivienne Press and Lyrr Thurston in Johannesburg; then Robyn Arnold, Meg Kemp, Eldaleen Jacobs and Lizél Kleingbiel in Pretoria – and, in Hollard Street, Lily Mitchell's editorial networking. Dr Hennie Smith's unfailing moral support was always there, representing the 'man from the ministry' in the Kelvin House days and, later, the interests of the Academy. Incomparable production services were provided by Claire Kearney in Johannesburg and Dr Nico Dippenaar in Pretoria.

ASSAf

It is indeed to be celebrated, in this 120th year of the *SAJS*, that its future is assured now that it has become part of the operations of the Academy.

Declarations

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Reflections of an Editor-in-Chief: 2008–2012

I started as Editor-in-Chief of the *South African Journal of Science* (*SAJS*) in November 2008, and had a two-month overlap period with my predecessor, Graham Baker, who had been in the job for the previous 36 years! Having served on the Journal's board myself since 2003, when ASSAf took over management of the Journal, I had some idea of the changes I wished to implement, and how I might go about doing so. ASSAf had already decided on a different model for the role of Editor-in-Chief. Graham had been a full-time employee, whereas I had accepted a three-year contract (subsequently extended for a further year), in terms of which ASSAf bought out 40% of my time from my home university where I continued to work for the remaining 60%.

The next decision involved the only other position attached to the Journal – the editorial assistant, who was also responsible for tracking the manuscripts and chasing up reviewers. My department in Stellenbosch offered us office space (as it had done for other staff members who edited journals), and my own preference was for the incumbent to work under my supervision there. ASSAf declined this suggestion on the grounds that as this position was a permanent one, it would be better for the incumbent to work at their offices in Pretoria with their other staff. So provision was made for me to make quarterly visits to the Pretoria office. We advertised the position and were lucky enough to appoint Linda Fick. Rather than being a secretary, I asked her to take responsibility for copy editing the Journal (a task my predecessor had undertaken himself). She has remained with the Journal ever since, and has indeed provided an important source of continuity (and much else besides) to successive editors.

Not being a polymath myself, I had never understood how my predecessor had made decisions on manuscripts in every field of science from theoretical physics to molecular biology. So I came up with a list of broad fields, largely on the basis of past content of the Journal, and we advertised 10 Associate Editor positions in different disciplines, including one in humanities and social sciences. Historically, the Journal had not published much outside of the natural sciences, but as ASSAf was an academy encompassing all areas of knowledge, we needed to encourage more submissions in this area. I was delighted that we ended up being spoiled for choice in choosing associate editors, and in the first issue of 2009 we announced what turned out to be an outstanding new team.[1] I remain grateful to them for sharing my vision for the niche which the Journal should occupy, and tackling it with commensurate enthusiasm. The vision I outlined in the first leader: "We aim to publish original work of importance in any field, which will interest readers from more than one discipline. In particular, we are keen to publish work that has a regional focus on Africa." We called for three categories of peer-reviewed contributions: reviews, articles, and research letters, and emphasised that these should be relatively brief compared to that of more specialised journals.

Our second important function, I felt, was to serve as a forum for debate about recent developments in research and in higher education. The front section of the Journal had in the past covered news, news features, book reviews, obituaries, commentaries, letters, and news and views articles. (The last category comprises articles which opine on important recent developments either in the published literature or at conferences.) Based on my experience working on a freelance basis for *Nature* for the previous 20 years, I was eager to expand this section of the Journal, and unlike in the past, not to avoid controversy if at all possible. In order to ensure timeous publication of current material, these contributions were not formally peer reviewed, and potential authors were encouraged to liaise with the Editor-in-Chief before submitting work of this nature to the Journal.

I hoped that the new model – combined with the use of an online submission system from 2010 – would lead to much more rapid publication of peer-reviewed manuscripts, typically three to four months after receipt. In the context of reviewer fatigue, this hope appears to have been a vain one – If anything, turnaround times have become slower over the past decade.[2]

In addition, we made the important decision that the Journal would be open access through a new portal established by ASSAf: www.scielo.org.za. Unlike most other open-access publications, we decided – crucially – not to charge publication fees in an effort to make *SAJS* a flagship African journal in which the continent's scholars could publish important multidisciplinary work without this financial stricture. This meant that ASSAf was paying for this from their parliamentary grant. I was grateful to the ASSAf Council for their support in this matter, and in retrospect I feel that this decision proved to be a wise one.

Our Associate Editors went about soliciting articles, and it is interesting now, more than a decade since my term ended in 2012, to be able to reflect on the impact of the work published during this period. Of the 50 articles published in 2009–2012, the six most-cited articles were – unsurprisingly – all reviews, with Wits geologist Terence McCarthy's 'The impact of acid mine drainage in South Africa' topping the list.[3] The second was a review of marine phylogeography in South Africa with lead author Peter Teske, then at Rhodes (and a former PhD student of mine at Stellenbosch).[4] And the third was a review by Timm Hoffman, Adam West and others from the UCT Botany Department on Drought, climate change and vegetation response in the succulent Karoo.[5] The most-cited (original) article was from Andrew Venter and collaborators of North-West University, on air quality assessment in the industrialised western Bushveld Igneous Complex.[6]

I was particularly delighted that we published an article with the late Bob Brain as lead author on The first animals: ca. 760-million-year-old sponge-like fossils from Namibia, which made a splendid cover story.[7] It has been well cited, and I expect will continue to be for a long time. I first met Bob in 1982 when, as a national serviceman in the SA Air Force, I attended seminars at the former Transvaal Museum, an institution which he directed and which I had perceived as an oasis in the intellectual desert of Pretoria at the time.

We struggled at first to break into the market in humanities and social sciences, and only 4 of the 50 most-cited articles published during my tenure were in this category. We published a fascinating (and well-cited) article by the

UCT historian Elizabeth van Heyningen on the Boer concentration camps in the South African War.[8] It in no way attempted to deny the tragedy of the high mortality of people in the camps – her grandfather had not only fought on the Boer side in the war, but was a "bittereinder"! But her thesis that attempts to solve the problem of health conditions in the camps had had serendipitous positive spin-offs, was mischievously misrepresented by elements in the Afrikaans press. I was infuriated when our publisher at the time, AOSIS, apologised publicly on our behalf without consulting me or the author, as anyone who had bothered to read the article would have understood this. Another favourite cover story (and also in the top 20 for citations during my tenure) was Rhodes anthropologist Michelle Cocks' account of Xhosa cultural perceptions of the thicket biome.[9]

At my request, I was given a modest budget to commission contributions for the front section of the Journal, in an effort to stimulate debate about current developments in research and higher education in the country. Craig McKune did some excellent reporting on the crises at UKZN and the NRF and on the pebble bed modular reactor, in particular. In terms of expanding our brief beyond the natural sciences, we published a commentary by the eminent language scholar Neville Alexander[10], which was based on a lecture he had given at the University of Johannesburg – sadly, he died on the day that I finished editing the article. Peter Anderson and Bill Nasson wrote memorable obituaries for Stephen Watson; and Richard Dudley and Stan Trapido, respectively, as well as contributing book and exhibition reviews of high calibre.

By the time I finished my term at the end of 2012, the Journal's impact factor had risen from 0.5 (when I took over), to 0.8. Impact factors are calculated by measuring the average number of citations in a year to peer-reviewed articles published over the previous two years, so this factor related to citations in 2011 of articles published in our first two years as an editorial team (2009 and 2010). In July 2014, the impact factor relating to the last two years of my term was released, and it had reached 1.03, having doubled in four years. In practice, turning a journal around takes time. But the trajectory was in the right direction, and consequently my successors have had to handle many more manuscripts each year than I did. Over the next decade, the impact factor continued to climb and has more than doubled again – it is currently 2.1.

With hindsight I took over the Journal at the beginning of a new era in the history of our young democracy. On a direct level, South Africa had survived the financial crisis relatively unscathed, but had not really benefitted to the extent to which it should have during the resources boom of the noughties. In April 2009, a new President was elected who presided over a regime intent on looting state infrastructure, arguably the most valuable asset we had inherited from the colonial and apartheid eras, and our biggest advantage over other African countries. Consequently, we have had little chance of attracting investment on the requisite scale as global economic recovery proceeded. In a leader in November 2009, I lamented the decision to build the Medupi coal-fired power station, and bemoaned South Africa's commitment to a 34% reduction in carbon emissions by 2020 and 42% by 2025, as a case of "too little, too late"[11]. If only – the tiny reductions we have achieved to date relate only to Eskom's dysfunctionality.

In conclusion, I was lucky enough to serve as Editor-in-Chief during a relatively optimistic period in South Africa's history. The despair which has characterised the state-capture era did not yet prevail, and I was naïve enough to believe when I sat down to write a leader, that someone might take note of what I wrote. I hope that this at least served to stimulate interest within the academy, if not among the political class.

Declarations

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Reflections of an Editor-in-Chief: 2013–2019

In the last quarter of 2012, my appointment as Editor-in-Chief of the *South African Journal of Science* (*SAJS*) was confirmed, with the January/February issue of 2013 being the first for which I was responsible. So began one of the most satisfying and fulfilling set of responsibilities of my 50 years of working life as an academic teacher/supervisor, researcher, and senior university manager.

The editorship was, however, an entirely new and demanding experience – as I was concurrently assistant to a Deputy Vice-Chancellor for Research and Postgraduate Education.

I had a great deal to learn and was remarkably fortunate to have Susan Veldsman as my immediate manager, and a highly supportive two-person team: Managing Editor, Dr Linda Fick and Online Publishing Administrator, Ms Nadine Wubbeling. Their help and guidance were essential (then and for the next six or more years) to the continuing success of the Journal.

The year 2013 and those that followed were a time during which several important changes were made to the nature and operation of the Journal. The changes were the result of teamwork, of considerable discussion and, when needed, of research on the part of the team. Susan Veldsman was often consulted, and when required, some matters were referred to the Editorial Advisory Board. But in all cases, these developments were the result of thorough joint discussion.

The changes mentioned are not in any specific order. Important amongst them, however, is the issue of gender: over the almost seven years of my editorship, the number of women scholars who were Associate Editors increased from one of ten to seven of ten, while membership of the Editorial Advisory Board progressed from one woman amongst five to three amongst six. The position of Associate Editor Mentee was introduced in 2018, with three of the four mentees appointed in the first year (2018/2019) being young women.

Of equal importance to the Journal's stature and recognition, and equally important for the scholars submitting their research to the Journal, was the change in the measure of international impact, the so-called impact factor. In 2012, the impact factor was 0.84, and by 2020 it had increased to 2.2. This represented a significant shift in the way in which the Journal came to be recognised.

Amongst these seminal changes, the Journal became online-only from 2016. This was in line with a growing practice in academic journals as they adjusted to an increasingly digitised world, and the online platform served to make the Journal available to an even wider and more diverse audience. At the beginning of 2014, Dr Fick introduced a section in the announcements of each issue of the Journal's publication that included lay summaries of key articles in the issue. This section was titled 'Editors' Choice' and helped in raising the Journal's appeal.

Yet other changes included the acceptance of preprints (mostly in the primary natural sciences) as they had, strictly speaking, not been published previously, and authors often benefitted from the feedback they received. Linda Fick and Nadine Wubbeling developed an increasing number of successful ways of providing data regarding the nature of published papers to me, the Associate Editors, and members of the Editorial Advisory Board; these data included the home countries of authors, discipline ranges and variations over time, the time taken to review and then to publish papers, and related (useful) information such as readership metrics for the intended audiences.

One of the *specific* aims of my term was to place emphasis on recognising science as being of relevance to society more generally rather than only to the scientific community. In a 2015 leader (*SAJS* vol 111 no 9/10) I wrote:

> *To make the most of science, it is now more important than ever to celebrate the contributions that it makes, across the spectrum of disciplines, whether individually or collectively. It is in this way that science contributes significantly to the well-being of ourselves, the environment on which we depend, and the richness of our world: genetics, agriculture, meteorology, music, literature, and so on. How might we possibly live without the benefits that they, and their fellow disciplines, all offer?*

To support this, many of my leaders focused on the ways in which scientific knowledge is received by the public at large and the issues and insights which it offers as far as understanding the quality of social life through the application of scientific insights. For example, one leader was an analysis of South Africa's National Development Plan's (NDP) Education, Science, and Innovation chapters – a Plan whose aim was to eliminate poverty and reduce inequality by 2030. (Sadly, within five years the NDP was hardly mentioned any longer, as I commented in my final leader in March/April 2019.)

One of the interesting benefits of this approach to the content of these 40 or so leaders, is that, over the years since 2013 (despite *not* being research papers), they have been cited over 1500 times in the research papers of authors from a wide range of nations.

Apart from the Editor-in-Chief's core work, two or three additional responsibilities added further interest: chairing meetings of the Associate Editors was always a source of great interest and engagement, as were meetings of the Board of the *Quest* magazine, published by ASSAf for Grade-11 and -12 school learners, and first year university students. That Board brought together a wide range of members whose views on the magazine were of considerable value.

Then, too, there were occasions when it fell to me to serve on one of the panels of the DHET-ASSAf process for assessing books submitted by university staff members to be considered for DHET subsidy awards. These

meetings allowed for debate and discussion among scholars from varied disciplines. Subsequently, my time with the Journal also created the privilege of interviewing seven eminent scholars and then writing chapters on each for the book *Legends of South African Science.*

In this reflection on my term as Editor-in-Chief of this remarkable Journal, now in its 120th year of publication, many colleagues made my years with the *SAJS* rewarding and enriching. So my very sincere thanks and warmest good wishes go to Roseanne Diab, Susan Veldman, Linda Fick, Nadine van der Merwe (née Wubbeling), Michael Cherry (my predecessor – and my honours student at UCT), Leslie Swartz (current Editor-in-Chief and amiable correspondent) and the many collegial authors of published papers who became friends.

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Reflections of an Editor-in-Chief: 2019–2021

On 26 February 2019 I was honoured and delighted to be informed that I, an historian by training and with a specific interest in the history of the natural sciences, had been appointed to the part-time position of Editor-in-Chief of the *South African Journal of Science* (*SAJS*), a publication with a long history and a high reputation. I knew, of course, that for almost a century it had been the most important multidisciplinary journal in the country providing items of scholarly news as well as publishing original research in a manner that could be understood and appreciated by non-specialists. It was a publication with which I was familiar and that enlightened me on topics beyond my disciplinary field, so I accepted the post with several specific objectives in mind and these are explained below.

During the initial months of my tenure, my predecessor, John Butler-Adam, was of enormous assistance with wise advice and guidance. So too was the staff of the Journal. Managing Editor Linda Fick and Online Publishing System Administrators, first Nadine van der Merwe and then Nadia Grobler. This team, who produce and publish the Journal, manage design and layout, general appearance and despatch with technical expertise and experience, could not have been more patient and helpful.

Before I could get to my main objectives as Editor-in-Chief, however, I found a full inbox of submissions demanding my attention almost every day. Evaluating their initial suitability for publication, in terms of subject, novelty, importance, geographical and disciplinary focus, writing style, and interest to a wide range of readers was a tremendous learning experience. Working closely with the Associate Editors and their mentees who handle manuscript acceptance, peer review assessment and readiness for publication, was extremely satisfying and among them I made many personal friends.

I had been an ASSAf Member since 2012 and it was a pleasure to be integrated into the ASSAf community, interacting with the President, Jonathan Jansen, and Council Members as well as the Executive Officer Himla Soodyall and others. It was rewarding to be included in the numerous initiatives run by the Scholarly Publishing Unit under the expert direction of Susan Veldsman. Within a few months, I became familiar with the workings of the Journal and ASSAf and began to feel comfortable about suggesting future direction and activities for the publication.

The first objective to which I gave attention was to institute a strategic plan to provide a clear framework for the editorial function. This had been under discussion for some time but never finalised. Beginning in July 2019, we held a series of consultative meetings with the publishing team, with the Executive Officer, and with the Editorial Advisory Board. The draft strategic plan, which I presented to the ASSAf Council and senior managers at a meeting in February 2020, was approved. It offered a clear vision and mission for the Journal to align more closely with ASSAf's own updated strategic plan. It also expanded and strengthened the Editorial Advisory Board to include scholars who were world leaders in their fields and thus to raise the stature, profile, and expertise of the Journal, both in South Africa and internationally. After being approved by the ASSAf Council, the first meeting of the expanded Board took place in September 2020.

My second strategic aim was to broaden the readership and contributions, particularly among younger scholars. But I also wanted the many ASSAf Members, SARChi Chairs, and highly rated National Research Foundation researchers, as well as officials in the Department of Science and Innovation, the CSIR, NRF, and other research bodies to submit material. I had envisaged giving personal presentations at conferences and on university campuses to explain the merits of publishing in our outstanding multidisciplinary Journal as well as in specialist outlets. To this end, in December 2019, the Journal hosted a successful round table of senior scholars in a panel to deliberate on the topic 'Pure or applied science in the Age of the Anthropocene: which does South Africa 2030 need more urgently?' at Science Forum South Africa (CSIR Conference Centre, Pretoria) where it, and the Journal, attracted considerable attention. This particular subject had arisen in a previous issue of the Journal and the panel was the suggestion of Kevern Cochrane of Rhodes University. Around this same time, I visited North-West University to speak to postgraduate biology students about publishing in the Journal. Regrettably, after March 2020 the COVID-19 pandemic intervened with restrictions that made personal contact impossible. In June 2020, I represented the *SAJS* as a (virtual) panellist at the European Conference on Research Ethics at the University of Aveiro (Aveiro, Portugal), but the face-to-face marketing opportunities were lost.

My third goal was to reconsider Associate Editor portfolios. This was necessary partly because of the complexity of the humanities and social science disciplines and we also needed to ensure that ASSAf Members were appointed in these roles. The question of peer review was another matter that required attention because it was becoming more difficult to find willing peer reviewers and the review process frequently took far too long. This frustrated good authors and discouraged their willingness to publish in the Journal. There were additional matters to which we, as a team, needed to give attention. For example, improving our statistics and monitoring to gain more knowledge of authors and readers and actively to fill gaps in diversity of disciplines and authorship. I was also keen to see all the back issues of the Journal digitised and, as an historian, I would like to have been able to make a stronger case for working within a different referencing system that would be more user friendly for the humanities and social sciences than Vancouver; one that allowed for explanatory notes as well as sources and references.

During my term of office, five issues of the Journal highlighted specific themes. One explored the challenges of dealing with marine plastic waste and pollution and was the suggestion of, and guest edited by, Linda Godfrey, Manager of South Africa's Waste RDI Roadmap Implementation Unit at the CSIR. Other issues had special sections devoted to COVID-19 and to peer review, both highly topical at the time. It was a particular pleasure to share, with Teresa Coutinho, our Associate Editor for Agriculture and Forestry who was the Guest Editor, the celebration of 2020 as the International Year of Plant Health with an issue full of landmark articles on this subject. Owing

to ongoing COVID-19 restrictions, we were unable to launch this issue as planned at the large congress of the South African Society of Plant Pathologists that was to be convened at the end of 2020, but we did so, virtually, in January 2021. The use of specifically themed issues, especially on topics of immediate public interest is of immense value.

An unusual compilation issue that appeared in 2020 on the theme 'Intellectual and social critique: The role of the *South African Journal of Science'*, was precipitated by vituperative – even libellous – social media attention created by a commentary authored in a previous Journal issue by Professor Nicoli Nattrass, one of South Africa's leading social scientists. Her article on the study choices of black students triggered fierce controversy and exposed the vulnerability of a mainstream scholarly journal such as the *SAJS* to undisciplined populist pressure and unacademic conduct. With strong support from ASSAf, and the work of the publication team who shouldered additional burdens at very short notice, a special issue was published that contained an extensive rejoinder from Nattrass flanked by a variety of responses to her original contribution. The purpose was to frame disagreements responsibly within the parameters of academic freedom and scholarship in appropriate fora for academic debate.

After two years in the Editor-in-Chief position, I took the decision to return to my home discipline and concentrate on personal projects. My period in office was hugely rewarding; I had been exposed to some extraordinary and varied research in different fields and had interacted with interesting professional teams at ASSAf and beyond.

Declarations

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SAJS and the politics of inclusion and exclusion: An editor's reflections (2021–2024)

I have been lucky enough to have been Editor-in-Chief of the *South African Journal of Science* (*SAJS*) since early 2021. When I learned in 2020 that my application for the post had been successful, I was struck by a mixture of delight and terror. In some ways this mixture will be familiar to any scientist who lands a big research grant – it is wonderful to be successful, but success marks the beginning of a period of hard work. In this case, however, there were some added concerns.

I am a clinical psychologist by profession and training, and shortly before beginning at *SAJS* I had completed a late-life second PhD, this time in English, built around a creative non-fiction memoir. As an undergraduate at the University of Cape Town in the 1970s, I had completed a combined degree, something which is no longer offered – I did a combined BA and BSc degree in Psychology and English, with sub-majors in Mathematics and Mathematical Statistics. This combined degree suited me perfectly as a young scholar with a strong interest in writing and in the social sciences, but also fascinated by the natural sciences and especially with numbers and statistics and with what they can and cannot tell us. My immediate predecessor as Editor-in-Chief was the globally renowned environmental and science historian Jane Carruthers. Like me, Jane is not a natural scientist, but her leading scholarship on histories of science, and especially histories of science in and of South Africa[1] and her ability to inform the readership of key global developments in the evolution of scientific terminologies[2], to name two examples, placed her expertise in a special category. For the most part, though, my predecessors were esteemed natural scientists, globally known as Jane was, and though there is much to the cliché of standing on the shoulders of giants, there is also a long way to fall when the giants are tall.

There were longer shadows to my anxiety. I knew that I would be starting work at a journal which was very well functioning (quite how well, I did not learn until I started the job – there is a truly remarkable team at the Journal), so what extra, if anything, could I offer? I was also worried about the inevitable intertwining of the Journal with the broader political history of our country. The *SAJS* had been around for almost 120 years, and in that time, there had been only two Editors-in-Chief who were (white) women; I was the latest in a very long line of white men. I did not know who else had applied for the position and I was mindful of the fact that I had not appointed myself, so there must be some confidence in me personally. I also knew that the team who had appointed me must have been aware of imbalances in participation in science in South Africa on the basis of race, class, gender, disability and so on. But I could not deny that in my identity I embodied something – a tradition of exclusion and privilege. None of this was caused by any of my predecessors, and I knew many who had done their best to promote inclusion, but by my identity I reinforced the pattern. I was also aware that I was joining the Journal at a time when debates about race were particularly 'hot' at the Journal, following the publication of a commentary by Nattrass[3]. Indeed, shortly after I started at the Journal, a potential reviewer indicated to me their refusal to review for us, on the grounds, according to them, that the Journal supported racist practices. I was not so naïve as to think that people with different ideological positions would not view my role at the Journal as problematic for a range of reasons; I also thought, though, that there were more important things to worry about than my own identity and how it would be perceived, and that I should focus on those.

I came to my role at the Journal with long experience in journal editorial work, both in South Africa and further afield (a product, as I was well aware, at least partly of my own unearned privilege). But I had been Editor-in-Chief of only one other journal, and this was the *African Journal of Disability*, which was started in 2012 by myself and others. That journal was specifically what may be termed 'developmental' from the start – we were explicitly interested in the work of first-time academic authors, and especially African authors with disabilities. Through my work at that journal and previous engagements with very talented African activists with disabilities[4], I saw evidence of the harsh realities of processes of exclusion from knowledge – exclusion of people, and also exclusion of different kinds of knowledges. The reality and importance of histories of exclusion have long been recognised in South Africa[5], and, as an aside, it is only in 2024 that arguably the globally leading journal in my home discipline, *American Psychologist*, published a major article dealing with epistemic exclusion[6]. It is not by accident that African, and specifically South African, scientists and ethicists have been at the forefront of drawing attention to vast inequities in science, as witnessed by the Cape Town Statement on fairness, equity and diversity in research, authored by Lyn Horn and colleagues[7].

No journal can deal on its own with the enormous challenge of moving the field forward while addressing broader equity concerns, but I believe that it is important to make a contribution. As part of this, at the *SAJS* we have increased support for new and emerging authors, through free online monthly support group meetings[8], and at least twice-yearly longer workshops, focusing on issues such as journal writing skills and peer review skills, recordings of which are available on our YouTube channel. These meetings are well attended by people from a range of African countries, and our focus is on helping authors with publishing and peer review issues in a range of disciplines and journals, and not just our own. Although we receive consistently excellent feedback on these endeavours, we have not yet formally evaluated their impact, and this is a drawback, but it is important to recognise that this work is not part of the Journal's formal remit (we are not an educational or training institution, so we do this work, and, I believe, enjoy and benefit from it, as something of an extra). We are aware of the huge issues of imbalance in the pipeline of well-prepared scholars, which starts in the school system and probably earlier.[9] We are also aware of the barriers and challenges within the higher education system itself for progression and development of talented young scholars, notwithstanding important initiatives to address this.[10–13] An added challenge, of course, is that entangled with the generally well-intentioned wish to 'build capacity', there may be, to greater or lesser degree, a

reproduction of histories of privilege and paternalism, a positioning of the 'emerging scholar' as somehow inherently weak or less competent than those doing the 'capacity building'[4] – an issue I discussed earlier in 2024 in a webinar, using, in part, the work of the *SAJS* as an exemplar. As long ago as 2001, Deborah Posel[14] noted that, in order to assess progress on employment equity and other important goals of the newly democratic South Africa, the country was resorting to using, and re-inscribing, the highly problematic apartheid 'racial' categories. Similarly, a recent book by Sharad Chari focusing on Durban is fittingly entitled *Apartheid Remains*.[15] All that we hope for, and achieve, in a better present is also inextricably intertwined with and often built on, a past we would sometimes rather forget or dispose of. This is true of all histories, no less so of the history of trying to contribute to changes in our Journal.

In this regard, in 2022, we introduced our new Inclusive Language Policy[16] after a long period of consultation and refinement – a document which we hope will grow and change over time. Unsurprisingly, perhaps, our attempt to help authors navigate the complex terrain of how to refer in an inclusive way to markers of race, gender, gender identity, sexual orientation and disability (to name the main categories we deal with), although widely applauded, was experienced by some as offensive, unnecessary, and patronising. There were also objections to our suggestion that authors should write as clearly and directly as possible, should avoid unnecessary jargon, and should be aware that most of our readership are not first language English speakers or expert in every subject which the Journal covers. Perhaps the most trenchant criticism in this regard was that our policy (which in our view was entirely consistent with and not a dramatic departure from what the Journal already had in place), if implemented, would reduce the level of *SAJS* to that of *Quest*, an ASSAf publication aimed at a very broad population, with a particular focus on school-level educators and the learners they teach. Although I am clearly not objective when I suggest that there has been no detectable decline in the academic rigour of the Journal since we introduced the Inclusive Language Policy, what I can say is that I believe the policy to be, like all our policies, subject to change and improvement, but also helpful and signalling a commitment to inclusion on our part. We have not done enough about the question of language – although I feel proud that we now share social media posts in a range of languages spoken in South Africa and further afield, we have not yet done enough to grasp the nettle of science communication and linguistic and cultural exclusion. We have been keen to solicit and publish (after our usual quality-control processes) items dealing with issues related to language and science[17–20], building on a tradition of work in the Journal going back many years. But there is clearly more to do.

I joined the Journal when the world was still in the throes of the COVID-19 pandemic, and we have had a number of pieces published on COVID-related issues, both before and during my time at the Journal, including the important special issue guest edited by Jonathan Jansen and Shabir Madhi, entitled, 'How to do social distancing in a shack: COVID-19 in the South African context'. Although COVID-19 and its aftermaths (like apartheid, in a slightly different sense) are still very much with us, it is worth reflecting on how the technological changes associated with managing the pandemic have had profound effects on the Journal and how it works. I have never been to the offices of ASSAf in general, or of our Journal, and it was only in my fourth year at the journal that I met most of my closest working colleagues face to face for the first time. I still have not met in person most of our Associate Editors, our Associate Editor Mentees or most members of our Editorial Advisory Board. In spite of this, I feel very warmly part of a collegial group, and supported by all. I feel much closer emotionally to some of my *SAJS* colleagues than to some people I see regularly in person at my own university. I don't fully understand this, but the issue of virtual versus in-person collaboration, of what communication technologies can and cannot achieve for the progress of science and research more generally, is an important topic for the future.[21] Related to this, I am proud that our Journal was early in developing a Policy on the Use of AI and Large Language Models, and to be part of broader ASSAf and SciELO endeavours in this area, but the terrain is shifting fast and we cannot be sure where this will take us.

During the worst of the COVID-19 pandemic, there were two truisms that I often heard expressed. The first of these was that, although a novel challenge, the pandemic exposed issues that were there all along – it shone a light on what was previously in plain sight, but commonly not seen, especially regarding questions of inequality, exclusion, racism, misogyny, disablism, and so on. I think this is indeed so. The second thing commonly said is something I am far less sure about. Many of us have claimed that COVID has permanently and fundamentally altered how we view and live in the world. When I see the empty corridors in the university department where I work, I do see a dramatic change in work practices and social connections, especially as I know how easily I can reach colleagues online, wherever they are. But in other ways, and perhaps in similar ways as I have discussed the inevitability of social reproduction even in the context of deliberate change, I am not sure that COVID changed all that much, despite how it unsettled us all. This is, of course, a question for further research, and I do not feel qualified (nor do I wish) to prognosticate on what lies ahead for the next 120 years of the *SAJS* (should the Journal, or any journals, still exist). I have found in my very privileged time at *SAJS* that the balance between the comfort of familiarity and the unsettling excitement of challenge and change has made for a time of huge, and happy, learning for me. For this, unequal though I often feel to the task of being Editor-in-Chief of this Journal at this time in this country on this continent and in this world, I am very grateful.

Declarations

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On becoming an electronic-only, diamond open access journal, through the lens of a managing editor

If I have seen further, it is by standing on the shoulders of giants.
Sir Isaac Newton

When joining a journal that is over 100 years old (as I did in 2009), you understand that you are "standing on the shoulders" of all those who came before you.

In my 16 years of working at the *South African Journal of Science* (*SAJS*), I have been privileged to work with many talented, hard-working and inspiring people, some of whom have reflected on their experiences elsewhere in this special issue. I was fortunate to join ASSAf at a time of significant changes for *SAJS* – the expansion of the editorial model to include associate editors and the adoption of open access being the two changes that would drive growth in both the multidisciplinary content and the digital footprint of the flagship journal of South Africa's national academy. It was a time of immense potential, but also an immense responsibility to 'inherit' such a national treasure and be tasked (alongside others) with building upon its strong foundations.

When I started in 2009, it was as editorial assistant; my role quickly evolved to assistant editor and then managing editor, concurrently with the journal evolving from a print-first to an electronic-only journal.

Other contributions in this issue cover the history of the Journal before 2009, and the contributions and perspectives of others over the last few decades. This Commentary provides the perspectives of a managing editor on the evolving technical and operational aspects of publishing the *SAJS* since 2009 – the start of its journey from a print-first to a diamond open-access electronic-only journal – in an evolving publishing landscape.

From print to digital: Expanding reach and access

Many assume that publishing a digital journal is easier than publishing a print journal. The opposite is true, at least in my experience. There is much more involved in electronic publishing than authors and readers ever see or realise.

Figure 1 presents an infographic summarising the digital evolution of the *SAJS*. Below, I briefly chronicle some of the major developments in transforming the *SAJS* from a print-first to an electronic-only publication.

The *SAJS* became available online – behind a paywall – from the late 1990s to early 2000s. Up until 2010, the print (PDF) files were uploaded after the journal issue had been printed. As a print-first journal, this meant that articles sometimes started or ended halfway on the page. It was only with the adoption of digital-first publishing that journal articles all started on a new page – a rather small, but significant, sign of the shift to electronic publishing.

In 2010, the Journal adopted an online content management system (Open Journal Systems, or OJS) for submission, peer review and publication.[1] Prior to this development, submissions were emailed and catalogued using a Microsoft Access spreadsheet. An online system allowed for some functionality, such as reviewer reminders, to be automated, and for easier recording, monitoring and reporting of assigned tasks and manuscript status changes. New electronic publishing file formats – HTML, XML and EPUB – were introduced thereafter. From 2010, Digital Object Identifiers (DOIs) – unique and persistent links – were added to published articles and registered with Crossref, for easier and persistent access to the digital articles. In addition to accessibility, DOIs allowed reciprocity and interoperability with other Crossref services – Cited-by linking, CrossCheck (now Similarity Check), FundRef (now Open Funder Registry), and text and data mining – which were progressively adopted. Together with the introduction of ORCID IDs and other digital tools such as citation export and social share buttons, these tools – although not all noticeable to users – function to ensure the interoperability of the Journal and to optimise the visibility, accessibility, indexability and searchability of the content; in short – they extend the reach of the journal articles within the digital landscape. Increased visibility and accessibility were evidenced through a 93% increase in website views over the 5 years from 2013 to 2017. Website views continued to increase, stabilising at about 100 000 views per annum from 2020 onwards.

With the focus shifted to developing the Journal as an electronic publication, the print edition was downscaled and eventually discontinued altogether in 2016. The evolution to an electronic-only journal was not without resistance and some on the Council of the Academy of Science of South Africa (ASSAf) needed convincing. So, to ease what was an uneasy transition for some, print subscriptions were gradually decreased and full digital issues were introduced in three formats – PDF, EPUB and flipbook – in 2014 to eventually replace the print version. The full digital issues, together with the Table of Contents and Editors' Choice for each issue, were (and still are) distributed via email to readers who signed up to receive these email notifications of each new issue. The number of digital subscribers grew from about 1200 recipients in 2014 to 15 000 in 2017, where it has remained, with the number of new subscribers signing up balancing the number of those who do not open the emails being removed from the mailing list.

The reach of a digital (open access) publication is far greater than that of a print copy, because of the ease with which it can be shared. Although it is not possible to measure the full reach and impact through all online platforms, harvesters and indexers, electronic publishing also enabled the generation of new metrics such as

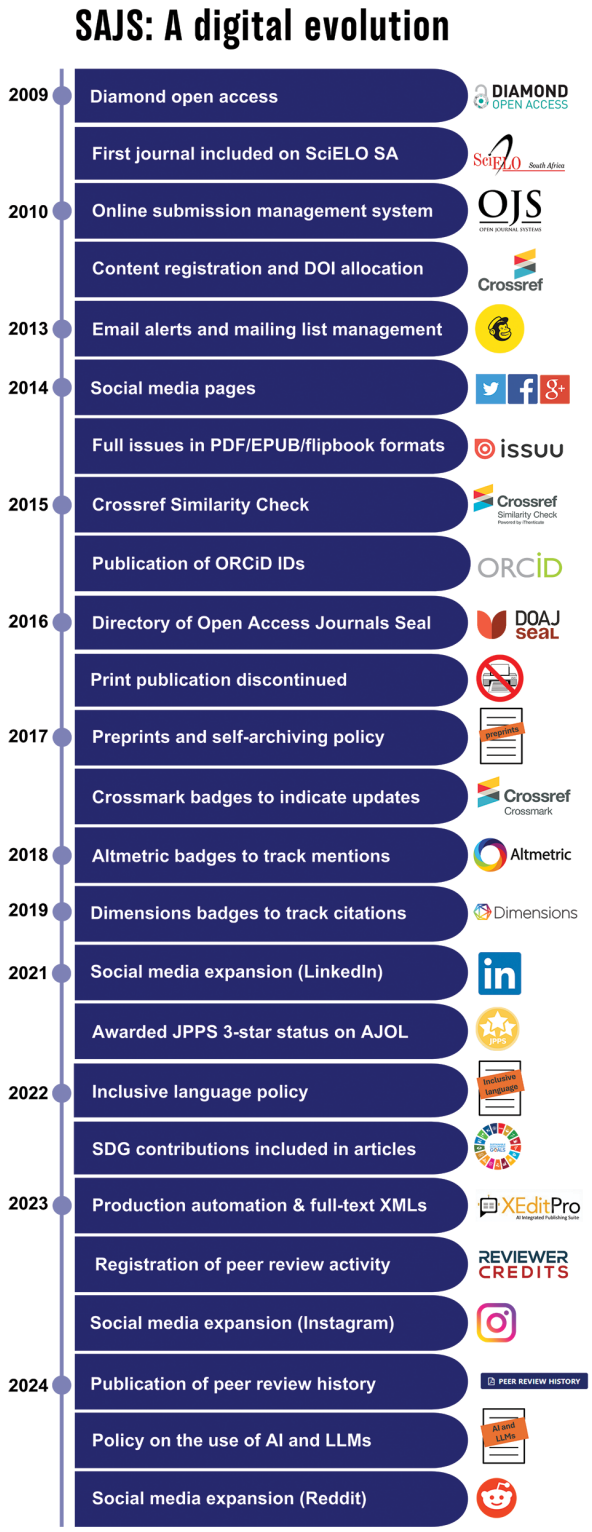

Figure 1: Infographic summarising significant changes that occurred in the digital evolution of the *South African Journal of Science* (*SAJS*), 2009–2024.

views, downloads and the Altmetric score (which quantifies usage via mainstream and social media). The advantage of these metrics is that they are article-level metrics as opposed to the impact factor, which is a journal-level metric.

In parallel with the development of the Journal into an electronic publication, the number of submissions continued to grow – from 220 submissions in 2009 to 700 in 2015, stabilising at 400–450 in the last few years.

Although discontinuing the print edition reduced production costs, electronic publishing is not free. The digital tools were acquired at a very reasonable cost; however, their implementation required greater human input. Ongoing digital development of the Journal therefore required an expansion of capacity: the creation of a new position, Online Publishing Administrator, in 2013. Nadine Wubbeling was the first incumbent in this role, first part time and then full time. This position was later upgraded to Online Publishing Systems Administrator, and Nadia Grobler took over this role in 2020.

Gone were the days of receiving manuscripts in the mail, of imposition guides, of sorting reprints for authors, and of posting copies to a few hundred subscribers. Now the manuscripts were submitted, reviewed and published online – and could be read, translated and shared *globally* by anyone with an Internet connection. Users could comment on and interact with the content, and all of these interactions – views, downloads, social shares – could be measured and quantified as an indication of the impact of the content. The inevitable shift to a digital landscape enabled rapid expansion globally in terms of the visibility, searchability and accessibility of the Journal.

From postbox to inbox: Communicating published research digitally

The evolution to a digital publication also opened up options for sharing the published content more widely – with the media as well as the public. The creation of the Online Publishing Administrator role also enabled the introduction of social media – Facebook and Twitter (now X) in 2014, and later YouTube, LinkedIn, Instagram, and, more recently, Reddit. These platforms have shown steady, albeit modest, growth.

A formal communications strategy was developed in 2016 to further the reach of the published articles, and has been effective in terms of garnering media exposure. Because of its scope and multidisciplinary, non-specialist style, the Journal is well positioned to deliver South African science to the media and wider public in a manner that is both understandable and trustworthy. In addition to the above-mentioned announcements of each new issue, the communications strategy has included embargoed media releases and social media posts for each published article. In 2023, the social media posts were expanded to include translations, primarily in Zulu and Afrikaans, but also in other languages, as provided by the authors. The articles in each issue which receive the most interest – as determined through views and engagements on the website and social media, respectively – are highlighted in the 'Readers' choice' section on the website. The articles featured in the Editors' choice consistently receive more online views than other articles in the same issue, in part because they are subsequently featured in media reports. An article on fossil cancer published in 2016 – and featured in the Editors' and Readers' choice – was reported on extensively in local and international media and appeared in the Altmetric Top 100 articles of 2016. All mainstream news coverage of articles is shared under the 'SAJS in the news' section on the website. Since July 2016, when this section was first introduced, there have been over 600 media mentions of articles published in the *SAJS*. Over the last 5 years, the print, online and broadcast media coverage of *SAJS* articles has had a reach of 56 million, amounting to an advertising value equivalent (i.e. what it would cost to place an equivalent 'sized' advertisement) of ZAR43 million.

From closed to open: Open access, open data and open policies

After establishing the Journal as an electronic journal, the focus shifted – in line with the global paradigm shift – to making the Journal more open, not just in regard to accessibility, but also in regard to open data, open peer review, and greater transparency.

SAJS – as the flagship journal of ASSAf, the official national academy, is funded by ASSAf as its publisher, and ASSAf, as an entity of the national

Department of Science, Technology and Innovation, is funded by this Department. This funding ensures the sustainability of the Journal as a diamond open-access journal – that is, neither authors nor readers pay to submit to or publish in or to read the Journal.

This support from ASSAf has been unfailing and unquestionable – the Journal and Journal staff are fortunate to have a publisher for which open access and open science, in parallel with transparency and integrity, are a given, and not something to be compromised or negotiated. And ASSAf's role as publisher of *SAJS* is critical to the strategic direction and successful implementation of its scholarly publishing and open science activities.

In March 2009, *SAJS* became the first journal on ASSAf's newly launched SciELO South Africa (SciELO SA) platform – a premier full-text database of selected peer-reviewed, open-access South African scholarly journals. SciELO SA is part of the global SciELO Network and has grown to 111 journals in the last 15 years. Inclusion in SciELO SA marked the paradigm shift to open access and *SAJS* was openly accessible for the first time. Back issues (to 2007) were also included, and thus open access, on SciELO SA. In 2010, ASSAf entered into an agreement with Sabinet to digitise the older (1905–2007) hard copies as part of the African Journal Archive, an open-access collection funded by the Carnegie Corporation of New York, thus ensuring open access to the full digital archive.

In line with SciELO requirements, and the recommendations of the Budapest Open Access Declaration to ensure unrestricted access to and re-use of material[2], a Creative Commons Attribution licence was adopted in 2010; *SAJS* authors retain copyright of their material and give the Journal a non-exclusive, irrevocable licence to publish the material under a Creative Commons Attribution licence, which means that anyone can read, download, copy, distribute, adapt and search and link to the content without needing permission, provided that the authors are acknowledged and cited. The Budapest Open Access Declaration extends free access to literature to unreviewed preprints that authors place online "for comment or to alert colleagues to important research findings"[3]. In keeping with removing barriers to access, the *SAJS* requirement of originality was amended in 2017 to exclude preprints on recognised preprint servers such as arXiv, thus allowing authors to share preprints without compromising subsequent submission to *SAJS*.

As a newly open-access journal, the *SAJS* was included in the Directory of Open Access Journals (DOAJ) in 2010. However, in March 2014, DOAJ implemented stricter criteria for inclusion, which meant that all listed journals had to reapply for inclusion. From more than 10 000 journals originally listed, only 3700 were accepted after reapplication.[4] *SAJS* was not only accepted for re-indexing in 2016, it was also awarded the DOAJ Seal – a mark of certification granted only to open-access journals that achieve a high level of openness and adhere to best practice and high publishing standards.

During International Data Week in 2016, we announced that *SAJS* authors would be able to publish a link to the open data supporting their published articles. Authors are encouraged to deposit their data in a reputable open repository that follows the principles of data management and citation and the link to the data set in the repository is published on the *SAJS* website together with the article, ensuring that the data set is visible and accessible to readers to promote data sharing and re-use and to facilitate compliance with funding mandates. The accompanying open data sets are indicated in the published articles through an open data icon. Later, we added an icon to indicate preregistration of a study protocol on a recognised portal. These icons are based on the 'badges to acknowledge open practices' initiative of Blohowiak et al.[5] Published articles with open data sets and pre-registration still are in the minority in the *SAJS*.

One aspect of openness that has not been readily adopted is open peer review. The *SAJS* follows a double-anonymous peer review model in accordance with the recommendation of ASSAf's *Code of Best Practice in Scholarly Journal Publishing, Editing and Peer Review.*[6] Whilst open review models enhance transparency and accountability, a double-anonymous model is most likely to reduce status, gender, institutional and other bias in peer review.[7–9] An online, open survey conducted in 2017 to assess *SAJS* users' readiness for an open peer review model yielded only six responses; although the responses received were supportive of open peer review, the lack of responses was indicative of a mismatch at that time in the uptake of open science initiatives between authors and the drivers of open science – funders and publishers.

As a 'best of both worlds' approach, the peer review policy was amended in 2023 to allow for the publication of anonymised review reports and the authors' response to the reviewers of published articles. This approach promotes openness and transparency and retains the benefit of the objectivity of double-anonymous review. Reviewers and authors of accepted manuscripts are encouraged to give permission to publish anonymised review reports and the response letter. Since adoption in October 2023 for implementation from 2024, 80% of authors and 70% of reviewers have agreed to publication of the peer review history, which is then published alongside the PDF and EPUB of the article and can be accessed from the article page on the Journal's website.

An evolving publishing landscape: The good, the bad and the ugly

An African proverb says, "It takes a village to raise a child." And it takes a community to publish a journal. A community of authors, reviewers, editors, advisory board members, copyeditors, typesetters, and publishing professionals, all with the common goal of creating a journal volume of high-quality research – in our case, high-quality original research with a relevance to Africa, for a wide local and global audience, to showcase African research to the world.

The scholarly publishing landscape is continually changing, and the last 16 years have witnessed several major changes. Many of these have been mentioned above: the digital transformation, the rise of open access, preprints, data sharing and reproducibility concerns, open peer review and article-level metrics. Challenges that have emerged or risen, in part as a result of the ease of online publishing, include plagiarism, predatory and hijacked journals, paper mills, image manipulation, and, more recently, AI-generated text, images and peer review reports.

How can scholarly journals combat these challenges? Among others,

1. By having clear policies and guidelines and ensuring adherence thereto. And regularly reviewing and revising these, both pre-emptively and responsively.
2. Through providing training and capacity-building. Since 2021, the Journal has been hosting annual journal writing and peer review workshops and a monthly 'Journal writing and peer review forum' (an open forum for emerging researchers in all disciplines to discuss related issues and receive support and guidance).[10]
3. By recognising and rewarding excellent scholarship. Annual awards for an outstanding article and outstanding reviewer were introduced in 2021 to recognise outstanding contributions of authors and reviewers. Recognising the work of reviewers is an ongoing endeavour, and an important one. Finding willing and responsive reviewers has become an increasing challenge for all journals globally. In 2023, *SAJS* joined Reviewer Credits, a platform to recognise registered reviewers who review for the Journal. Through integration with ORCID, the review activity is also reflected in the reviewer's ORCID profile.
4. And by showing authors and readers that the journal is trustworthy, through maintaining quality and integrity, evidenced through inclusion in reputable indexes such as SciELO SA, Web of Science, Scopus and DOAJ. Inclusion in these indexes is through meeting strict evaluation criteria. In addition to inclusion in SciELO SA, Web of Science and Scopus and receiving the DOAJ Seal in 2016, the *SAJS* was awarded a 3-star Journal Publishing Practices and Standards (JPPS) rating (the highest rating) through African Journals Online (AJOL) in 2021. According to the JPPS framework, journals that receive a 3-star rating are "consistently excellent in all the technical and editorial publishing best practices set out in the JPPS assessment criteria"[11]. *SAJS* is currently the only journal on AJOL with a 3-star JPSS rating.[11]

There has also been a much-needed focus on diversity, equity, accessibility and inclusion in scholarly publishing in more recent years. The Journal published its Inclusive Language Policy in 2022. This policy has two main features: the importance of using accessible, clear language and writing in an inclusive way.[12] Equity and diversity are more difficult to achieve but are given consideration in appointment of editorial board members. In addition, the Associate Editor Mentorship Programme was initiated in 2018 as an opportunity for early career researchers to gain valuable editorial experience working with an experienced Associate Editor in a discipline represented in the Journal. Since 2018, 15 early career researchers have joined the *SAJS* editorial team as Associate Editor Mentees – an experience which should afford them greater success in future editorial roles.

Initiatives like the SDG Publishers Compact[13] have brought to the fore the role and relevance of scholarly publishers in accelerating progress in achieving the Sustainable Development Goals (SDGs) by 2030. From 2022, all *SAJS* articles have included the SDGs to which they contribute.

The journal of the 21st century is a dynamic entity; and seems to fulfil an ever-increasing number of roles with ever-increasing responsibility as a guardian of published research integrity.

Last words

As we celebrate the 120th volume of *SAJS* this year, I am struck by how quickly the last 16 years have passed by, by how much has changed in that time, and especially by how much change still awaits the *SAJS* – not least of which are the potential and pitfalls of generative AI in scholarly publishing.

Publishing a high-quality, multidisciplinary, non-specialist, open-access journal that all South Africans (including researchers, policymakers and the general public) will want to read – whilst meeting best practice and tight deadlines – is no small task for a small publishing team, and has not become any easier over the years. We have sometimes failed, or failed at first, but we are continuously learning and striving to do better.

To all past and present *SAJS* colleagues, I owe my gratitude for a journal that I feel proud to be a part of. To my successors (whoever and whenever they may be), I wish you success and all the opportunities and challenges from which I had the benefit of learning. To all whom I have had the privilege of working with in the last 16 years, my thanks for our interactions and for making this one incredible journey (so far!).

Acknowledgements

It is not possible to list all the editors, colleagues and service providers I have had the good fortune of working directly with over the last 16 years, but I acknowledge each of them for their contributions, not only to the *SAJS* but also to my professional development. In particular, I thank the current '*SAJS* team' – Leslie Swartz, Nadia Grobler and Phumlani Mncwango – for making a challenging job fun, their predecessors, Nadine van der Merwe (née Wubbeling) and Xolani (Sbonga) Dlamini, and all my ASSAf colleagues for being part of the *SAJS* village. I am grateful to Nadia Grobler for creating the infographic for this article, and for her many other contributions through her role as *SAJS* Online Publishing Systems Administrator.

Declarations

This paper was written in my capacity as Managing Editor of the *SAJS*, and as such, a full-time employee of ASSAf; I have no competing interests to declare. This paper contains no AI-generated content.

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A bird's eye view of the *SAJS* through the lens of the ASSAf Executive Officer

It is a great privilege for me to serve as the third Executive Officer of the Academy of Science of South Africa (ASSAf) after Professor Wieland Gevers, and then Professor Roseanne Diab. I took on this role in November 2018, have served one term, and am now into the second term of my appointment with endorsement from the ASSAf Council. While many things change in the national landscape due to local and global challenges, one constant is the timeous bimonthly publication of the *South African Journal of Science* (*SAJS*). It happens so smoothly, by a well-organised team led by the Editor-in-Chief, with support from the Associate Editors, the Managing Editor and her support team, collectively overseen by the *SAJS* Editorial Advisory Board.

During my tenure as Executive Officer, it was necessary to conduct interviews to appoint two Editors-in-Chief of the *SAJS*. The first resulted in the appointment of Professor Jane Carruthers in February 2019, who served as editor from 1 April 2019 to 29 January 2021, and the second of Professor Leslie Swartz, now in his second term, having started in January 2021. Both are remarkable individuals and they each have brought their unique skills and perspectives to enhance the *SAJS*.

While I do not contribute much to the day-to-day activities of the *SAJS*, I am reassured by the professionalism and dedication of the Managing Editor, Dr Linda Fick, whose superb skills in editing and publication ensures high-quality articles in the Journal. I look forward to receiving the 'Highlights' from selected articles for the forthcoming volume; not only does it show the diversity in the scope of publication, but it whets one's appetite for the full publication. Having it available electronically has made access easy, quick, and available at anytime from anywhere.

A multidisciplinary publication with relevance to society – and in many instances to the making of evidence-based public policy

Professor Gevers' article in this issue, entitled 'Some reflections on the *SAJS* – an unbroken thread in our national life since 1905', gives more background into the past 120 years of the *SAJS*. As a multidisciplinary journal, its impact factor has grown steadily. Figure 1 shows the Clarivate Web of Science Journal Impact Factor (JIF) and quartile from 2019 to 2022, with a slight drop in JIF for 2023; Clarivate's methodology changed in 2023 to include integration of the Emerging Sources Citation Index.

The *SAJS* received 420 submissions for peer review in 2023/2024, and about 38% of submitting authors were based in South Africa. The rejection rate was 95%. Of a total of 133 articles, including (guest) leaders, 57 were peer-reviewed articles: 1 Research Letter, 50 Research Articles and 6 Review Articles. The number of articles per category varies from year to year; in 2023, these articles were distributed into the categories shown in Figure 2.

Of the 22 discipline-specific categories featured in the Journal between 2019 and 2023, articles on Human Society and Environmental Sciences featured prominently, followed by Biological Sciences, Earth Science and Agricultural, Veterinary and Food Sciences. Creative Arts and Writing and Mathematical Sciences featured at frequencies less than 1% (Figure 2). It must be emphasised that a significant proportion of the articles contains findings and recommendations that have a direct bearing on public policy and the possible solution of problems in society.

Given that South Africa and other nations have committed to the United Nations 2030 Agenda for Sustainable Development, the *SAJS* has been tracking publications in the Journal that address the Sustainable Development Goals (SDGs) (Figure 3). Articles were recorded for 16 out of the 17 SDGs at varying frequencies, with no articles featuring on SDG 9 – Industry, Innovation and Infrastructure. More articles on SDG 3 – Good Health and Wellbeing – were published in 2023/2024, but articles related to poverty (SDG 1), reduced inequalities (SDG 10) and gender-related issues (SDG 5) featured less prominently in *SAJS* in 2023/2024.

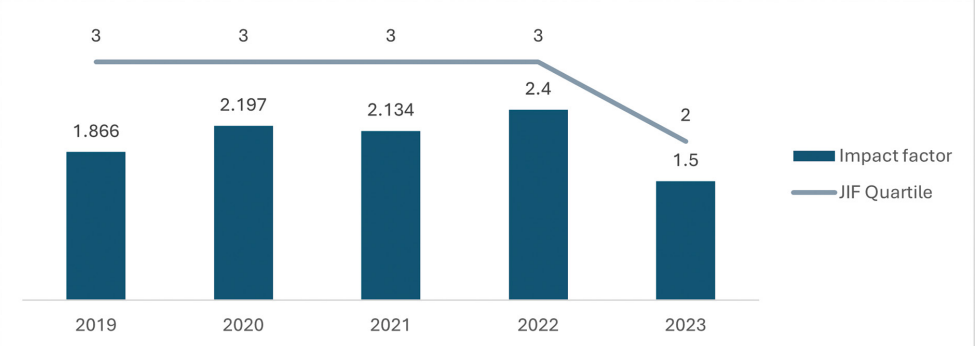
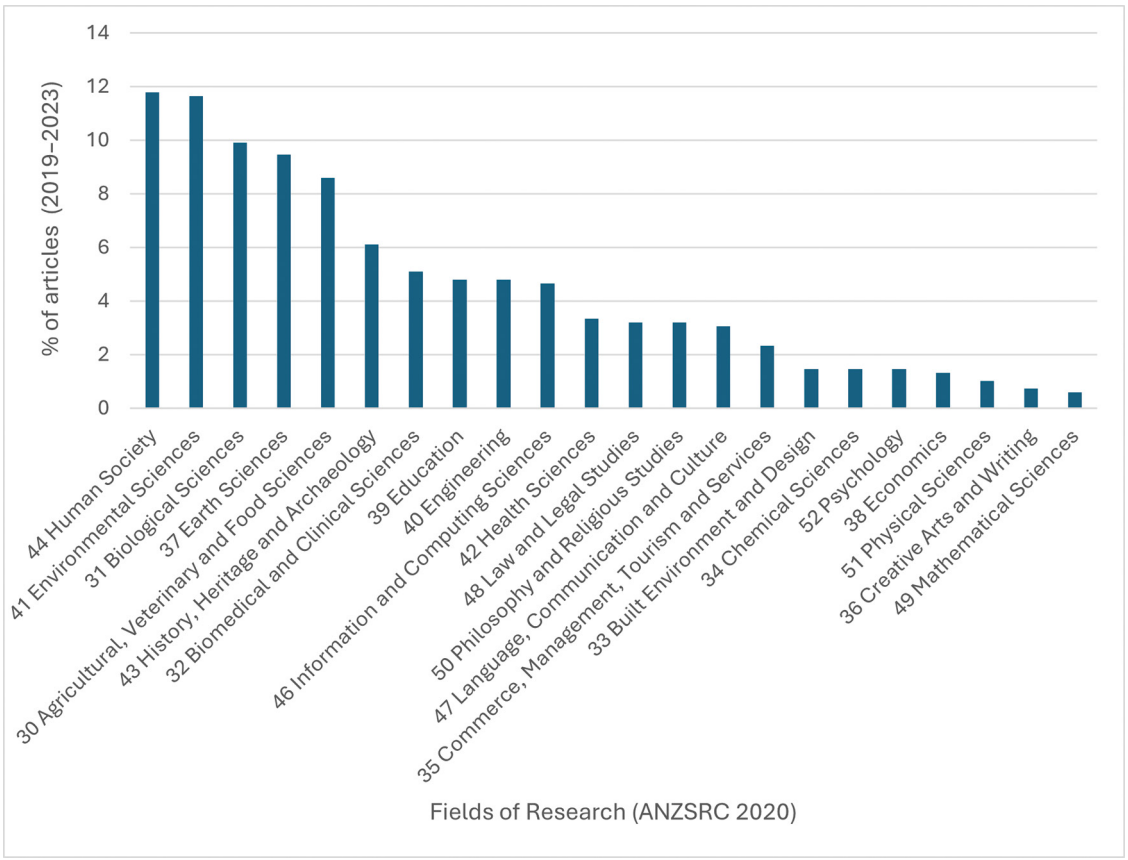
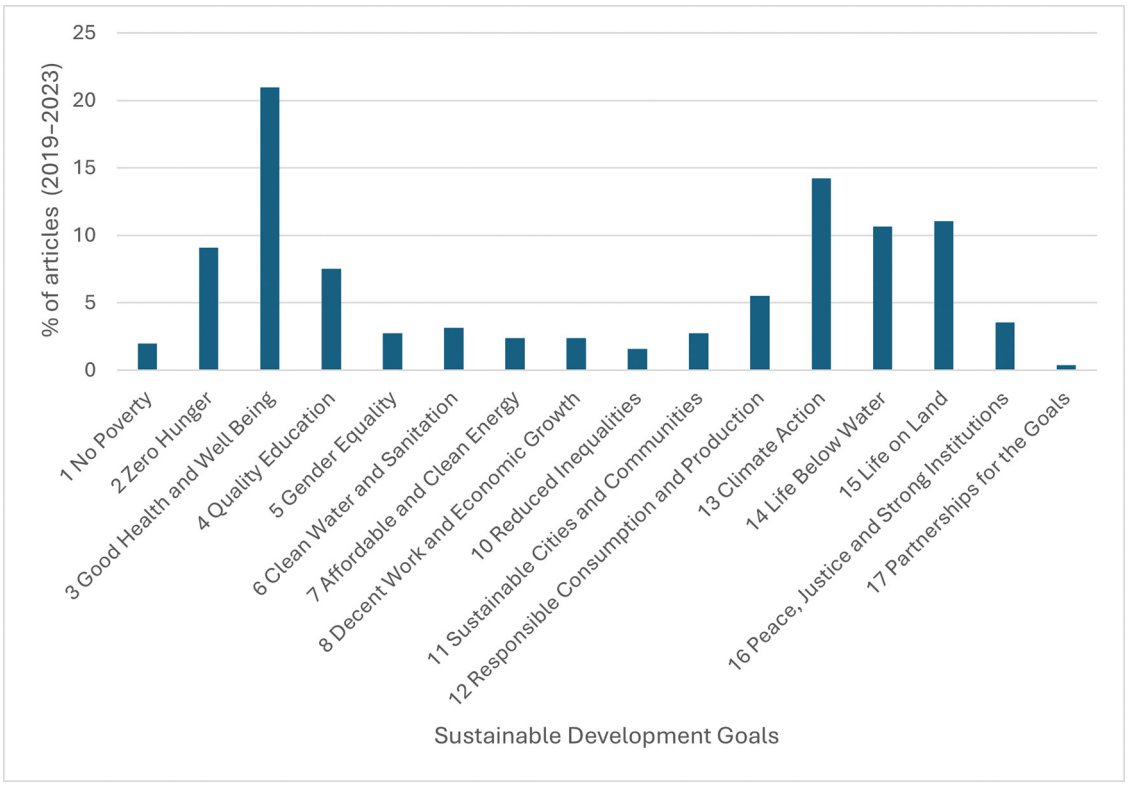


Figure 1: Journal Impact Factor (JIF) of *SAJS* for the years 2019–2023.



Source: Dimensions

Figure 2: Percentage of published articles, by discipline, in 2019–2023.



Source: Dimensions

Figure 3: Number of *SAJS* articles published per Sustainable Development Goal (2019–2023).

Advancing the ASSAf Five-year Strategic Plan (2020/21–2024/25)

ASSAf's Five-year Strategic Plan is built around profiling and strengthening the ASSAf brand and mandate within the landscape of the National System of Innovation by orientating its strategic objectives towards outcomes, outputs and services, including: (1) Independent, authoritative and influential scientific advice, (2) Science engagement, (3) Mobilising knowledge, (4) Facilitating partnerships, (5) Scholarship support, and (6) Supporting transformation.

Activities within the *SAJS* contribute in various ways to objectives 2, 3, 4, 5 and 6 that support the ASSAf Transformation Strategy as well as the Science Engagement Strategy.

In 2023, the *SAJS* hosted two workshops. The first, entitled 'Writing for a Scholarly Journal', was held on 8 June 2023, and was aimed at postgraduate students and emerging researchers with little or no experience of writing and publishing journal articles. Over 1000 participants were engaged, with the majority of participants from South Africa (81%). Among the participants, 40% were students or early career researchers (45%). Most of the participants were female (68%) and black (66%); 2% of participants were disabled. The feedback was overall positive, with 84% of respondents rating the workshop as excellent and 16% rating it as good.

The second workshop, entitled 'Peer Reviewing for a Scholarly Journal', was held on 13 September 2023, and was aimed at early-career researchers with little or no experience in peer reviewing journal articles. The workshop was presented by editors of the *SAJS* and a special guest presenter, Dr Martin Bekker from Wits University, who presented on AI in peer review. There were 765 registrants and 340 participants. Of the participants, most (66%) were early career researchers; most (65%) were women; 43% of the participants were black and 1% were disabled. Almost all (90%) participants were from South Africa, with 9% from other African countries.

In response to a growing need for capacity building in peer review, the *SAJS* introduced guidelines on peer review mentoring in 2023 and encourages invited reviewers to mentor emerging researchers when reviewing for the *SAJS*.

The *SAJS* has been hosting a monthly Journal Writing and Peer Review Forum since 2021. The monthly meeting is an open forum for emerging researchers in all disciplines to discuss related issues and receive support and guidance from the *SAJS* editorial team. This forum has since been growing in number – as of March 2024, there were 300 members.

The Associate Editor Mentorship Programme was expanded in 2023 and applications were invited for all portfolios for which Associate Editors agreed to mentor, that is, for four portfolios rather than the usual two.

Dr Amanda-Lee Manicum (Department of Chemistry, Tshwane University of Technology [TUT]) completed a two-year mentorship in 2023 and Dr Adriaan van der Walt (Department of Geography, University of the Free State [UFS]) completed a one-year mentorship in 2023. Dr Nkosinathi Madondo from Mangosuthu University of Technology, MUT (Social Sciences & Education Mentee) represented the *SAJS* and SciELO SA at the SciELO 25th anniversary conference in Brazil in 2023. The theme of the conference was Open Science with IDEIA (impact, diversity, equity, inclusion and accessibility), and Dr Madondo presented the Journal's Inclusive Language Policy.

SAJS Annual Awards

In 2021, *SAJS* introduced the *SAJS* Annual Awards, in which Associate Editors submit their nominations for the Outstanding Article and Outstanding Reviewer awards. Having served on the Selection Committee in 2024 for articles published in 2023, I can attest to the rigour of the review process and the criteria used, including a demonstration by the authors of promoting transdisciplinary work while using science to address societal issues.

There were seven nominations for Outstanding Article and four nominations for Outstanding Reviewer for 2023. The Outstanding Reviewer awardee was Jonathan Davy from Rhodes University. The Outstanding Article was awarded to 'A lifecycle-based evaluation of greenhouse gas emissions from the plastics industry in South Africa' by Taahira Goga, Kevin Harding, Valentina Russo and Harro von Blottnitz. The runner-up for the Outstanding Article award was 'Advancing ecosystem accounting in estuaries: Swartkops Estuary case study' by Susan Taljaard, Lara van Niekerk, Janine B. Adams and Taryn Riddin.

SAJS and social media

SAJS has used the media quite effectively in disseminating information. The mainstream media published 92 news reports on *SAJS* articles in 2023/2024, with an online reach of about 3.5 million. The advertising value equivalent (i.e. what it would cost to place an equivalent 'sized' advertisement) based on this coverage of *SAJS* articles was about ZAR2.15 million. Traffic to the *SAJS* website consistently increased on days on which media reports were published. In 2023/2024, there were just over 100 000 views of the *SAJS* website– an average of about 8000 views monthly. Articles published in 2023 were downloaded from the *SAJS* website over 133 000 times.

In addition to the social media posts on X (Twitter), Facebook and LinkedIn for each new article published, an Instagram account was created in November 2023 to further disseminate the published articles. To extend the reach and accessibility of the social media posts, they were translated into two other languages – predominantly Zulu and Afrikaans – from September 2023 onwards.

Conclusion

Few national academies have the privilege of hosting their own journal. It is with pride that ASSAf hosts the *SAJS*, offering a service to authors at no cost. The success of the Journal is due to the behind-the-scenes activities anchored by the Managing Editor around whom the Editor-in-Chief, Associate Editors and supporting staff operate. The process of finding reviewers, and then chasing them up for reviews is a challenging process, but one that is part and parcel of the publication process. ASSAf is indebted to all who participate during the various stages of the publication process and to the editors, past and present, who contribute unstintingly to ensure that the publication hub turns with all spokes in unison.

Heartiest congratulations to the Journal on its 120th anniversary, and I wish it well into the future.

Declarations

H.S. is the Executive Officer of the Academy of Science of South Africa (ASSAf), the publisher of the *South African Journal of Science*. There are no competing interests to declare. There is no AI or LLM use to declare.

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Professional development of early-career researchers at the *South African Journal of Science*

Significance:

To take the scholarship forward is one of the key responsibilities of any academic journal including the *South African Journal of Science (SAJS).* One way in which the *SAJS* takes the scholarship forward is by offering Associate Editor mentorship opportunities in fields represented in the Journal. In this Commentary, the current Associate Editor Mentees of the Journal reflect on the value of this opportunity to them.

Introduction

Mentorship involves an experienced individual sharing their acquired knowledge, proficiency, skills, values, expertise, perspectives, known resources, attitudes, and professional competence to facilitate the development of less experienced individuals.[1,2] Through the *South African Journal of Science* (*SAJS*) Associate Editor Mentorship Programme (AEMP), an opportunity is given to early-career researchers who are interested in acting in an editorial role. The duration of the *SAJS* mentorship is flexible, with a minimum of one year to be considered as completed, and there is no set limit on the number of mentees in any given year. The AEMP was initiated in 2018, with two mentorships offered each year up to 2022; from 2023 onwards, the number of mentorships offered has been based on the capacity of the Associate Editors.

The Associate Editor Mentee role involves mentees acquainting themselves with the entire editorial process from manuscript submission by an author until the manuscript is rejected or accepted for publication in the Journal. The AEMP allows a researcher to understand the long and stringent vetting procedure a manuscript goes through before being accepted for publication. The Mentee is shown the importance of their role as guardian to ensure only high-quality scholarly knowledge enters the scholarly record. The AEMP requires the Mentee to be open-minded and to critically review the quality of each submitted manuscript based on content and the ethical requirements of the field and of the Journal. Notwithstanding that the Mentee works in consultation with their Associate Editor Mentor, the editorial role undertaken by mentees carries a big responsibility. The Mentee, together with their mentor, determines the suitability of a manuscript for the next level of peer review after submission, and selects appropriate scholars in the field to review the manuscript and give their unbiased opinions on the scientific accuracy of the paper and the novelty of the research. Depending on the Mentee's professional experience and the reviewer comments received, the Mentee may propose the next steps to take regarding acceptance or rejection of a manuscript to the Associate Editor Mentor.

A mentorship process is expected to develop the intellectual, psychological, and moral characteristics of the mentee. The main aim of the AEMP is to equip mentees with the skills needed to perform the breadth of tasks generally assigned to journal editors so that they can in the future work independently as journal editors.[3,4]

Testimonials from past mentees

Past mentees who had completed at least one year of the *SAJS* AEMP were invited by the *SAJS* to provide feedback on their experience of their mentorship term. Their non-anonymised feedback could take any form. Out of a total of 10 past and current mentees, there were eight (8) respondents whose responses were independently considered and summarised by the current *SAJS* Associate Editor Mentees.

Overall impressions of the SAJS *mentorship programme*

The respondents described the mentorship as an enriching experience with a very supportive, patient, and encouraging editorial team. The most common feedback from respondents was that this mentorship was their first exposure to the editorial process and that they had little or no experience as reviewers. Their learnings about and their involvement in the editorial process cultivated in them confidence as an editor. Their editorial participation gave them exposure to the whole review process, from screening manuscripts for suitability for review to assessing reviewer reports and making editorial decisions based on these reports.

Some respondents described how their mentorship gave them a new appreciation for the challenges that come with successfully running a journal of the magnitude of *SAJS*. They also noted how their perspectives on the fundamental role that scientific journals play in the scientific landscape were shaped. The importance of having a strong and comprehensive network of peers and collaborators in the same scientific field was acknowledged. The commitment of the *SAJS* to fostering excellence in science and supporting the growth and development of the next generation of editors in South Africa was recognised and appreciated.

Career development opportunities emanating from the SAJS *mentorship programme*

Participation in the AEMP was cited for contributing to academic opportunities, such as acting as reviewers and serving as editors on the editorial boards of other local and international journals, becoming student supervisors, involvement in other prestigious programmes like the New Generation of Academic Mentorship Programme (nGAP), receiving researcher recognition through a National Research Foundation (NRF) rating and obtaining professorship. Two past *SAJS* mentees took over the reins as associate editors in their respective portfolios – Organismal Biology

and Archaeology, Anthropology and Palaeontology. One respondent was inspired to publish a book review in the *SAJS* and, in so doing, contributed to the knowledge economy of South Africa.

Learnings from the SAJS *mentorship programme*

The primary learnings from the programme included a greater understanding and appreciation for the role of an editor and the challenges the role presents. Respondents learned how to navigate this role and developed their skills in evaluating, reviewing and editing manuscripts. In addition, academic writing skills were acquired and refined and subsequently applied to the structuring and synthesis of ideas in the writing of the mentees' own manuscripts and grant applications. The mentorship programme taught some respondents how to work collaboratively with other editors and the Editor-in-Chief, and they were equipped with the skills to deal with conflicting reviews and opinions from other editors. Another learning that was emphasised was the ethical responsibilities that are attached to being an editor. Testimonials alluded to the ethical handling of manuscripts and general ethical conduct in scientific publishing to ensure a fair and transparent system.

Challenges faced during the mentorship term

The main challenge that the past mentees identified was finding willing and available reviewers. This challenge is not unique to the *SAJS*.[5] Finding suitable reviewers for manuscripts can be an arduous task because editors have to meticulously select reviewers who are independent, have no conflicts of interest and are appropriately qualified in the subject of interest. A major driving force behind the difficulty of finding reviewers is the pressure that universities put on their staff to publish a high number of papers, which means an increase in the number of submissions and reviews.[6] Attending to manuscripts methodically naturally becomes more demanding when submission volumes are high.

Another challenge that was identified by the past mentees was managing the workload between editorial duties and their primary academic responsibilities at their place of primary employment (usually a university). One mentee indicated that submissions in their portfolio – social sciences and humanities, in particular, education – were at that time very few. They felt that the limited number of submissions denied them the relevant experience in their field that they sought with this mentorship. As a multidisciplinary journal, the number of submissions to *SAJS* differs among portfolios and also between years, with the number of submissions ranging between 3 and 40 and the average number of submissions being 25. In addition, the type of manuscripts submitted to a particular portfolio may vary from time to time.

General comments

Overall, the respondents described their experience of the *SAJS* AEMP as being dependent on several factors, primarily the mentee–mentor relationship, prompt assistance and support from the editorial office, and an open communication channel with the Managing Editor and the Editor-in-Chief. In addition, the respondents reported that the mentorship was complemented by the opportunity for mentees to participate in all the Journal's activities and meetings where they could add their voices and contribute to the continual growth and development of the Journal. This foundation of support is a testament to a strong editor mentorship programme that develops and transforms mentees into independent editors. Taken together, the impressions from past mentees are that the AEMP helped them to develop their agency as researchers and engendered an academic citizenship that they plan to sustain in their academic careers. The respondents were unanimously grateful to the *SAJS* for the mentorship programme and its capacity-development endeavours.

Developmental opportunities nested within the *SAJS* mentorship programme

The AEMP provides numerous opportunities for the growth and academic development of mentees. Growth opportunities are in various forms, including participation in and presentation at writing and peer review workshops. To that effect, a workshop on 'Peer Review in Scholarly Journals' was hosted by *SAJS* on 13 September 2023. Shane Redelinghuys, a mentee from the University of the Witwatersrand, presented on 'What authors should know about peer review'.[7] The workshop was designed to share ideas regarding the nuances vital in peer reviewing, including but not limited to the manuscript's quality before it can be considered for peer review and whether the manuscript's argument is clear, methodologically coherent, focused, etc. During the same workshop, Nathi Madondo, a mentee from Mangosuthu University of Technology, presented on 'What reviewers should know about peer review'.[7] Nathi's talk was framed around the idea of taking scholarship forward; in other words, unsubstantiated claims or sweeping statements cannot contribute to the scholarship. Another mentee, Thywill Dzogbewu, presented in the workshop 'Writing with Integrity' on 5 June 2024. His presentation was on 'Deciding on authorship'[8], and he stated that authorship has to do with substantial intellectual contributions to a publication and is the currency for getting recognition in academia, including but not limited to attracting research grants. During this workshop, another mentee, Lindah Muzangwa, spoke on how data curation was crucial for any scientist and the need to manage the data for traceability and make it digestible for readers. She spoke of the context, usability and storage of data, which are all vital considerations when using data. She also explained the difference between data cleaning and data manipulation.[9]

Besides participating in workshops hosted by *SAJS*, during which mentees are afforded an opportunity to participate and develop in the context of scholarly publishing, mentees are also involved in the monthly *SAJS*-hosted 'Journal Writing and Peer Review Forum' and the Academy of Science of South Africa (ASSAf)'s Annual National Scholarly Editors' Forum (NSEF). The monthly writing and peer review forum is hosted virtually by the SAJS and is an open forum designed for emerging researchers in all disciplines. Emerging researchers like mentees are supported and guided in writing, peer reviewing, and publishing journal articles, and also provide this support to other emerging researchers through the Forum. Another great opportunity provided through *SAJS*, in collaboration with ASSAf, is when mentees are invited to be part of the Annual NSEF. To this effect, Nathi Madondo, on behalf of the *SAJS*, led a discussion during the Annual NSEF Meeting, which was hosted virtually by ASSAf on 11 April 2024.

In summary, the mentoring programme contributes immensely to the development of the mentees' agency in enhancing the knowledge, skills and practices valued in reviewing, academic writing and leadership associated with editorial work. Such development is conducted in a nuanced manner, given the enabling structural and cultural environment that is provided by the mentorship programme. By structure, we mean the programme itself, and by culture, we mean beliefs and ideas associated with mentoring, such as those identifiable in the discussion above. Consequently, as mentees, we believe that the programme has, in profound ways, on a continuous basis, taught us to be efficient, effective and ethical journal editors. In this way, we have learned and continue to learn how to discern good/excellent quality work from the manuscripts sent to the *SAJS*.

The challenges and future possibilities of the *SAJS* mentorship programme

Reflection and critical review of the mentorship programme have highlighted several challenges, competencies, and avenues for future consideration. These include editorial competency, competition with established voices, linguistic barriers, baseline skills development, communication skills, mentor roles, and continuous learning. These elements are crucial for scaffolding growth at the mentee level and ensuring continued development thereafter. Highlighting these aspects is valuable as many emerging researchers aspire to take on editorial roles, and the challenges discussed here may be common for those wishing to do so. Below, we offer a perspective on these challenges and future possibilities. It is by no means a comprehensive outline but one that hopefully assists with shifting the praxis of mentoring editorial interns and provides insight for those intending to become more involved on an editorial board.

Scaffolding skill sets is challenging at the mentor level.[10] Mentees at *SAJS* are a diverse group of emerging researchers from various academic and

social backgrounds. The programme's demographic thus captures a wide spectrum of the South African scientific community, with varied competencies, approaches, and pre-existing skills. Previous mentees have emphasised the importance of the mentor–mentee relationship, although it is not without challenges. Both mentors and mentees face increased time commitments and administrative responsibilities. However, this partnership is crucial as it forms the foundation of the mentee's learning experience. Studies have shown that mentorship programmes can significantly enhance mentee performance in contexts where efficient and positive communication is present.[11] Building a relationship on this premise creates a vital partnership pathway and is likely to foster more efficient scaffolding of skill development.

A strong mentor–mentee relationship that incorporates skills transfer and growth addresses the immediate challenge facing mentees: completing tasks related to the editorial process, which is new to most. Previous mentees credit the programme for immersing them in various editorial tasks, providing them with a comprehensive understanding of the entire editorial workflow. These tasks include managing initial submissions, identifying potential reviewers, negotiating with authors, reviewing submissions, and handling conflicting feedback. Many mentees aim to gain broad exposure to these processes, sharpen their technical skills, and navigate the complexities of academic publishing with confidence and efficiency. However, the range of tasks presents a steep learning curve involving the understanding of nuance and disciplinary discourse, ensuring integrity, maintaining high standards, being digitally proficient, and working dynamically in a team. Training sessions help ensure a smooth process and provide a foundation for learning, but ultimately, the development of necessary skills depends on the mentees and their mentors.

Equitable task distribution across portfolios also appears to be a challenge. Creating opportunities for all mentees to experience the full spectrum of editorial activities is crucial. This is one of the programme's strengths: offering comprehensive exposure to various editorial-related tasks. The editorial team manages the balancing of activities by assigning tasks to mentees, but mentees must also communicate their concerns to the editorial team to ensure fair workloads and exposure. At the beginning of the mentee's term, mentors ideally discuss envisioned objectives, allowing mentees to identify their goals for the programme. These crucial discussions help chart a path for the mentee's learning experience. Ensuring future mentees receive a uniform learning experience is important for all mentees to benefit from the extensive opportunities available in editorial work. This objective could be achieved by incorporating a communication framework for the mentor–mentee pair to ensure a mutually beneficial relationship between the pair.

Networking is another considerable challenge. A diverse and robust network of academics is vital in the journal landscape, enabling mentees to invite reviewers or seek assistance and advice. Facilitating these networks might help overcome this challenge, and the *SAJS*, along with ASSAf, hosts regular online engagements to assist in this regard. Structured networking events, alumni networks, and collaborative projects could also foster a growing academic network. Online resources, such as those provided by the Council of Science Editors[12], offer additional support and help create formal and informal professional relationships, benefitting the mentee cohort.

Recognising challenges and proposing solutions is essential, but must consider mentor and mentee time management. Balancing multiple responsibilities, including personal research, university administration, providing reviews, teaching, supervising, and offering editorial assistance, is difficult. Time management training, mentorship in time management, project management tools, consistent deadlines, and flexible work plans are several approaches that can help. Many of these options are in place at *SAJS* and are supported by peer and mentor support systems. These are not challenges unique to *SAJS*; other journals might also want to consider the suggested approaches.[13]

Innovative responses positioned within the mentee cohort can meet these challenges. Ultimately, the mentorship programme coordinators should ask themselves: where has it worked, where has it not, and what more can be done? From this reflection, the programme's future can be plotted, and necessary shifts in praxis can be enacted. Taken together, a communication framework for the mentor–mentee pair, time management training, assistance with project management tools, frequent formal meetings between the mentor and mentee and the editorial office, and a formal timeline for the current AEMP goals may help increase the effectiveness of the mentorship programme.

Concluding remarks

The *SAJS* Associate Editor Mentorship Programme, which has run since 2018, has significantly impacted the professional development of early-career researchers. The programme affords mentees the opportunity to gain hands-on experience in the editorial process, from manuscript submission to final publication decisions. Under the structured mentorship of senior associate editors, participants acquire essential skills, such as the evaluation of scientific content, adherence to ethical standards and managing the peer review process. The effectiveness of the programme lies in its provision of a supportive environment in which mentees engage deeply with the editorial process and contribute meaningfully to scholarly publishing, including making presentations on scientific writing skills. The mentees have faced challenges, such as balancing editorial duties with academic responsibilities and finding willing reviewers, but these are mitigated through the collaborative efforts of the editorial team and structured mentorship. The testimonials from past mentees highlight the role that the programme has played in enhancing the participants' confidence as editors and fostering an appreciation for the challenges of journal management. In conclusion, the programme's focus on continuous improvement and adaptation to the evolving landscape of academic publishing will ensure that it remains a cornerstone for developing capable professionals in scientific research and editorial work.

Declarations

All authors are current *SAJS* Associate Editor Mentees. There are no competing interests to declare. There is no AI or LLM use to declare.

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Historical perspective on 120 years of agriculture: Highlights from research published in the *SAJS*

Significance:

Agriculture, an essential pillar of South Africa's economy, has evolved through a century of scientific advancements. This Perspective highlights the significant research contributions to the improvement of citrus and maize production, addressing historical challenges and emphasising ongoing issues such as climate change, water scarcity and soil quality. The introduction of modern agricultural practices, including hybrid seeds, genetic modification, and advanced irrigation techniques, has transformed these crops, enabling increased productivity and global competitiveness. However, the sector faces persistent challenges, including the impacts of climate change and food security concerns, particularly in rural communities. We also explore future prospects, underscoring the importance of technology adoption and sustainable practices to enhance food security. South Africa's agricultural research, although underfunded compared to developed nations, remains crucial for sustaining the agricultural landscape and ensuring the sector's resilience and growth in an increasingly challenging global environment.

Introduction

The word 'agriculture' describes the multitude of ways that crops and livestock provide food and other products for the global human population. It is a practice of agroecosystem manipulation. Agricultural science is a multidisciplinary field that focuses on understanding and enhancing the productivity, sustainability, and profitability of agriculture. In South Africa, agriculture not only includes the commercial sector but also smallholder and subsistence farmers, who have sustained rural communities and shaped the agricultural landscape for centuries. Agriculture has been and still is a pillar of South Africa's economy, contributing 2.83% to the Gross Domestic Product[1] and providing 19.26% of total employment[2]. Agricultural land covers approximately 80% of the country's total area of 1.22 million km^2 of which only 12% is regarded as arable.[3] Agriculture has faced many challenges including, for example, the impact of climate change, pests and diseases, and the complexities of land reform and redistribution issues since 1994. Nonetheless, South African agriculture holds promise for future growth and development, both locally and internationally, as there is an increasing global demand for food and its sustainable production.

In this Perspective, we present some highlights of the agricultural research that has been conducted over the past 120 years (1905–2023) – the lifespan of the *South African Journal of Science (SAJS)* from which most citations were taken. However, when subject-specific journals began to appear, for example, the *Agricultural Journal of South Africa* in 1915, *Farming in South Africa* in 1927 and the *South African Journal of Agricultural Science* in 1957, authors preferred to publish in these journals, and fewer articles published on agricultural-related topics were published in the *SAJS*. For this reason, we included references from other journals. However, agriculture is such a broad and multidisciplinary topic that the focus of this review will be limited to research conducted on the production of citrus and maize and the challenges faced by these two sectors of the agricultural economy.

Citrus

Citrus trees, both oranges and lemons, were brought to the Cape from St Helena Island in 1654 and planted in the Cape Gardens.[4] By 1661, 1000 trees had been established, and, for the next 200 years, citrus was grown by small-scale farmers in the Western Cape. At the beginning of the 19th century, early settlers in the Eastern Cape and KwaZulu-Natal Provinces planted individual orange and soft citrus trees and, shortly after the Great Trek (1838), citrus trees were planted in the North West Province.

As the era of the *SAJS* began at the end of the 19th century, the then Prime Minister of the Cape Colony, Cecil John Rhodes, hired horticulturists, HEV Pickstone and RE Davies from California, to develop the citrus industry in the Cape. Thereafter, citrus trees were grown on a commercial scale using the modern scientific methods known at that time. High-quality citrus fruit was exported for the first time to the United Kingdom in 1906 and "made their debut at the Show of the Royal Horticultural Society in London"[4]. The industry flourished thereafter, and between 1906 and 1921, a number of co-operative grower associations formed, of which the most important were the Fruit Growers' Co-operative Exchange (1922), the South African Co-operative Citrus Exchange (SACCE) (1925) and the Citrus Board (1939).[5] Prior to 1941, the distribution and sale of citrus fruit were undertaken by individual producers, but in the year that the South African Citrus Scheme was introduced, sales increased as the fruit was sold in a "more profitable manner"[5]. By 1928, more than three million citrus trees were planted in the Cape. Today, the area occupied by citrus trees of all species and varieties is over 100 000ha[6], equating to approximately 55.5 million trees.

According to Fourie et al.[7], the first research officer posts were created in 1953 by the SACCE to undertake work on identified problem areas not adequately investigated by government and other research organisations. Between the 1960s and 1970s, three scientists, trained in California, were appointed by the SACCE in the fields of pre- and post-harvest pathology and horticulture. Their research was undertaken at the Citrus and Subtropical Fruit Institute in Nelspruit, which later became part of the Agricultural Research Council. The Citrus Improvement Programme was established in 1973 and later became known as the South African Citrus Improvement Scheme, managed by Citrus Research International. Scientists from this organisation conduct research on a range of topics relevant to their industry, including pathology, entomology and citriculture.

Maize

The introduction of maize into southern Africa is a matter of debate among archaeologists. Burtt-Davy[8] suggested that maize seed was exchanged for water, meat or other commodities by the Portuguese *en route* to the East in the mid-1600s. In the latter part of the 19th century, maize was mainly cultivated for local subsistence needs.[9] The market changed with the discovery of diamonds (1866) and gold (1886), and black and white farmers alike supplied maize to the rapidly expanding mining population.[10] "Two agricultures" then emerged: the black smallholder farmers and the white commercial farmers, the production potential of the former was suppressed while the opposite was true for the latter farmers who were supported by substantial investment.[11] Despite this initial division between the maize producers, which changed in the 1990s, South Africa increased its maize production from 328 000 tons in 1904 to 1.68 million tons in 1935[10] and 15.6 million tons in the 2022/2023 season[12]. This significant increase can be attributed to factors such as the use of hybrid and genetically modified seed, and improved fertiliser programmes and farming practices. Our understanding of plant genetics and the use of biotechnological tools such as marker-assisted selection and genetic engineering, for example, have allowed the industry to produce superior quality seed and plants resistant to pest infestations.

Maize is the most important crop in South Africa and is used both as animal feed and as a staple human food crop. Today the area planted to maize ranges from 2.5 to 2.8 million hectares annually.[13] The cultivation of maize is restricted by climate. It is considered a dry-land crop, and is mainly grown in the summer rainfall areas such as the North West and Limpopo Provinces.[8] In 1923, the "maize triangle" as it became known with Mafikeng (North West), eNtokozweni (Machadodorp) (Mpumalanga) and Zastron (Free State) forming the apices, produced approximately 60% of the total amount (1.5 million tons) grown in the country. The remaining 40% produced was produced by other provinces (KwaZulu-Natal and the Cape) and subsistence farmers.[14] Today, approximately 14 million tons are produced annually, mainly by commercial farmers, but small-scale farmers also produce a significant proportion of this amount.[15] Approximately 3.2 million tons are exported, mainly to Zimbabwe, South Korea, Japan and Taiwan.[12] The major producers are in the Free State, Mpumalanga and North West Provinces.[1]

Yellow and white maize, genetically modified with the Bt toxin, were commercially grown for the first time in the 1998/1999 and 2001/2002 seasons, respectively. South Africa then became the first genetically modified (GM) subsistence crop producer in the world.[16] Food security benefits attributable to GM white maize in South Africa are substantial and "an average of 4.6 million additional white maize rations annually" have been suggested.[17] Thus scientific research has played a pivotal role in the development and widespread adoption of using GM maize in the country.

Challenges

Water availability

Water is scarce in South Africa and severe droughts have impacted agriculture. Water scarcity has been exacerbated in recent years by erratic rainfall patterns[18], the needs of industries and cities, and impending climate change. There have been several drought investigations in the past, with the first published in 1914[19] and the most recent report published in 2020, namely, the National Water Security Framework for South Africa[20]. Over the years, drought relief plans and management practices were proposed, which included better veld, stock and water management, and improved farm management.

Crop irrigation using flood and furrow methods, as opposed to dry land farming, was first proposed in 1905.[21,22] Sources of water for irrigation purposes have been and still are from various aquifers[23], catchment areas and rivers[24]. The benefits of irrigation were highlighted in the *SAJS* by van Reenen[25] and Chunnett[26]. Other methods of water delivery and applications such as drip irrigation, developed in the 1900s in Israel, or the use of microsprinklers[27], were shown to be more water efficient than flood and furrow methods. These more efficient methods are the generally preferred irrigation systems in citrus orchards, as water is directly placed in the root zone and can also be used for fertigation.[28] In maize, supplementing rainfall during the mid-season drought period positively impacted yield[29] and this method has been shown to improve and stabilise smallholder farmer maize yields in particular[30]. Centre pivot-irrigation was first introduced into South Africa in the 1970s to irrigate the farm Soetvelde near Vereeniging.[31] This method enabled commercial farmers to increase quantities of water applied, and is used in some areas for maize production.[32]

Soil quality

As early as 1923, soil erosion, by wind and/or rain, was recognised as a significant problem in South Africa.[33] Policies were developed to prevent and mitigate erosion in the agricultural sector.[34] In 1939, the Soil Erosion Advisory Council was formed, and the *Soil Conservation Act* was published in 1946. At that time, all these efforts led to the effective control of erosion in some areas of the country. Today, however, over 70% of South Africa is experiencing some form of soil erosion, with the extent of the problem varying by region.[35]

Soil quality is multifaceted. Besides soil erosion, South African soils have also been subjected to structural decay, subsoil compaction, acidification, salinisation, pollution, nutrient depletion and surface crusting, resulting in reduced water infiltration, increased run-off and erosion.[36,37] A number of methods can improve and maintain soil quality, including the use of fertilisers. The low quantities of phosphorus in our soils were first recognised in the early 1900s and found to be the main limiting factor in crop production.[38] This led to the development of the first phosphate plant in Durban in 1903.[39] Fertilisers were also imported, with 19 000 tons of fertilisers imported in 1906.[40] By 1962, this amount had grown to 1 385 000 tons[41], and, in 2023, 2 174 911 tons were imported.[42] South African soils also have low organic matter levels, with about 58% of soils containing less than 0.5% organic carbon and only 4% containing more than 2% organic carbon.[43]

Pests and pathogens

The fields of entomology and plant pathology have a long history in South Africa that dates to the 17th century.[44,45] Pests and pathogens were and still are responsible for significant losses in agriculture, not only during production but also during storage. Initially, the most common method of management was pesticide application. Locusts, for example, were controlled with arsenate of soda[46], while diseases of grapes were controlled using sulfur with an amount of 264 tons used in 1916[47]. After 1919, inorganic pesticides were used, including Bordeaux mixture used to prevent numerous fungal diseases. After 1945, numerous synthetic pesticides were developed, many of which are still used today. However, many were detrimental to the environment and to humans. In the 1980s, sustainable farming was encouraged in an attempt to revise the harmful practices of applying increasing amounts of chemicals.[48] Today, management has moved from a reliance on pesticides to environmentally friendly options such as the use of biological control agents.[49]

Crop losses due to pests and pathogens are becoming increasingly more common. As pests and pathogens have the capacity to generate new variants containing key pathogenicity, fitness and aggressiveness traits, any new opportunity provided by climate change will be exploited by them.[50] Fluctuations in rainfall, humidity, temperature and carbon dioxide levels may also result in the emergence of pests in the field, an increase in their reproductive rates, shifts in their life cycle and movement from one area to another.[51]

Citrus

Doidge[52,53] described numerous citrus diseases caused by bacteria and fungi occurring in South Africa between 1919 and 1929. Bacterial, fungal and viral pathogens were and still are problematic pre- and post-harvest. Citrus canker, first detected in the country in 1905/1906, was successfully eradicated by 1927, and was the first plant disease to be successfully eradicated in the world.[44] Today, one of the most important citrus diseases is black spot (CBD), discovered in 1922 by Doidge.[7] The disease is not present in the Western Cape, Northern Cape and the Free State[54] and its presence on the fruit from KwaZulu-Natal, North West, Mpumalanga and Limpopo has impacted on the export market. The EU has strict regulations (zero tolerance) related to the import of

fruit from South Africa, both with regard to CBD and the false codling moth, as neither occurs in Europe. To improve risk assessment and CBD management, spore release prediction models have been developed.[55] The presence of viruses has also hampered citrus production.[7,56] The earliest recorded evidence of a virus causing significant damage was the citrus tristeza virus in 1896, which led to the abandonment of sour orange as a rootstock in South Africa.[7] The identification of the causal agent was, however, only confirmed in 1947.[4]

Entomological problems of citrus described in 1934 included red scale, citrus aphid, fruit fly, mealy bugs and thrips.[57] Today, many of these insects are still problematic. An additional problem with some pests is their ability to vector plant pathogens, for example, the citrus psyllid, which vectors the citrus greening pathogen.[58] Although insecticides have been used for many years, an integrated pest management approach is more widely accepted today.

Maize

Maize has been plagued by many pests and pathogens over the past century. In 1911, cutworm, stalk borer, the striped earworm and a leaf disease of unknown cause were problematic.[8] The number of new incursions of pests and pathogens steadily increased, with the fall armyworm making an appearance in 2017.[59] Pathogens such as those causing cob and stalk rot and storage rot produce mycotoxins and threaten the health of humans and domestic stock.[60] Leaf blight diseases include Northern and Southern leaf blights, grey leaf spot, common rust and maize streak virus, and may cause substantial losses each year.[13,61]

The development of Bt maize, engineered to contain toxins from *Bacillus thuringiensis*, has provided resistance in South African maize to important insect pests such as the European corn borer and other lepidopteran species.[62] In South Africa, Bt maize makes up more than 90% of the maize planted and has resulted in a significant reduction in pesticides usage, crop damage and attack by fungal pathogens.[16]

Climate change

A number of researchers have modelled climate change and the effects thereof on agriculture in southern Africa.[18,63–66] According to the IPCC 6th Assessment Working Group II report, climate change has increased the mean annual surface temperature of the earth by 1.2 °C, relative to 1850–1900, with the six hottest years ever recorded having occurred in the last decade. According to Blignaut et al.[67], South Africa became 2% hotter and at least 6% drier in the period 1997 to 2006 compared to the 1970s. During the same period, the use of water also increased significantly, with irrigation agriculture using 60% of total consumption. An increase in temperature and a decrease in rainfall are not the only consequences of climate change; there are increases in extreme weather events, heatwave intensity and frequency, severe droughts and flooding after torrential rains. The average rainfall across South Africa has also decreased in all areas except the northwest and, despite an overall trend in aridity, the intensity and frequency of heavy rainfall events have also increased. In addition to these abiotic factors, biotic stresses, such as an increase in pest and pathogen populations, and increased weed growth have had negative impacts on agriculture.

Climate change will impact both citrus and maize production, leading to possible decreases in yield.[68,69] In citrus, the effect will be physiological, resulting in a loss of productivity and fruit quality. Adaptation strategies such as canopy management, top netting, soil fertility management and water-saving approaches could be used.[70] Maize production by both commercial and smallholder farming systems is predicted to decrease by between 10% and 16% because of the projected climatic impacts.[69] One method of overcoming this challenge is to create new varieties, and in the case of citrus, new rootstocks, that can adapt to the predicted environmental conditions.

Johnston et al.[71] – in a report entitled 'Climate change impacts in South Africa: what climate change means for a country and its people' – recorded that commercial, small-scale, and subsistence farmers have implemented various climate change adaptation strategies. Conservation agriculture, which focuses on retaining soil carbon to enhance drought resilience, has become more important in dryland farming regions. Notably, improvements in irrigation efficiency, coupled with practical drought tolerant crop and cultivar selection, have become standard practices. In addition, there has been a noticeable decrease in reliance on chemical inputs. Access to medium- and short-term weather forecasts has been enhanced, empowering farmers to proactively prepare for extreme weather events. This includes leveraging indigenous and local knowledge of weather and climate patterns, as well as implementing water resource management techniques.[72] For instance, some farmers now harvest rainwater to sustain agricultural activities during dry periods, thereby prolonging the growing season. Due to these adaptations, the sector's economic sustainability has largely remained intact. Nevertheless, the escalating temperatures and the intensification of extreme weather phenomena pose difficult challenges to farmers' adaptive capacity. As such, ongoing efforts to innovate and implement resilient agricultural practices by both smallholder and commercial farmers will be essential in navigating the evolving climate landscape.[71]

Food security

The term 'food security' was coined in the 1970s.[73] Food supplies are deemed secure when every member of the population has access to sufficient food for living an active, healthy life.[74] There are four elements to the term: food availability, food access, food utilisation and stability.[51,75]

Despite the constitutional right of every South African citizen to sufficient food and water, food provision is complex and determined by various environmental, health, economic, socio-political, and agro-food-related issues. Over 20% of South Africans are food insecure, that is one in five members of the population, mostly from the lowest socio-economic groups[76], with about 55% of the population unable to pay for both food and other basic needs.[77] Widespread poverty, unemployment and inequality have exacerbated food insecurity. This has led to health issues such as obesity and hypertension.[78] One in four children have stunted growth because of poor nutrition.[79] There is an urgent need for significant investment in sustainable agriculture, the development of infrastructure, and poverty alleviation strategies to improve food security for all South Africans.

Perspectives

Despite all the challenges, agriculture remains a cornerstone of South Africa's economy, contributing 2.83% to the GDP. Over the past 120 years – the life of the *SAJS* – food production has increased due to genetic crop improvements, including the contentious use of GMOs, and cropping practices, notably irrigation and fertilisers.[80] Key issues that are likely to shape the agricultural future include the adoption of technology; adaption to climate change; sustainable production strategies; production of less studied, locally adapted plant species used in rural communities as food; and education. Technology, such as the use of genetic methodologies like genome editing, artificial intelligence, precision agriculture, drones and satellite imaging for monitoring, and apps for decision-making, have the potential to increase both efficiency and productivity in agriculture. In the case of maize, there is a need to breed new varieties that are drought tolerant, and in citrus, rootstocks and scions that maintain production and fruit quality in the face of climate change. Integrated pest management strategies, including the sensible use of pesticides and the adoption of biological control strategies, will be crucial for managing pests and pathogens while at the same time minimising their environmental impact. Under-utilised agricultural crops, or orphan crops, such as moringa[81] and *Plectranthus aeculentus*[82], can also contribute to food security. As agriculture will become more technology-intensive, at least in the commercial sector, skilled workers will need to be educated in fields such as data analysis and agricultural engineering. However, low capacity for adaptation, widespread poverty and low technology uptake might hamper agricultural productivity in South Africa.

In conclusion, South Africa's research focus areas are similar to those in the developed world, especially in terms of technology and infrastructure. Research conducted ranges from cutting-edge molecular studies to system modelling approaches. This is despite the fact that expenditure on research, estimated at 1.04% of the agriculture GDP, is significantly less than that of Europe (2.06%), the USA (3.7%) and Australia (4.02%).[83] It is, however, comparable to that of other developing countries. Since 2008[84], the government has recognised that South Africa needs to progress to a "developed state of agriculture and agroprocessing", especially in terms of technological innovation, so that

wealth generation and socio-economic development within this sector can be achieved within the next 20 years.[83]

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Declarations

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A brief narrative on *SAJS* communications on selected disease outbreaks of global significance in the last 120 years

Significance:

The *South African Journal of Science (SAJS)* is a multidisciplinary journal serving as an outlet for researchers' findings, opinions and perspectives, with a primary focus on South Africa and the African continent. The Journal aims to communicate to the general non-expert readership. In this Perspective, we aim to provide a brief overview of how the Journal has communicated disease outbreaks of global importance over the decades. *SAJS* is in a good position to contribute to the public understanding of biomedical science through periodic calls for contributions on emerging and re-emerging pathogens that have the potential to cause disease outbreaks.

Introduction

The role of a scientific journal is to disseminate findings judged to be of a generalisable nature, reliable, and of interest to its readership.[1,2] Disease outbreaks come with huge tolls in sickness and deaths, with far-reaching effects on the psychosocial and socio-economic well-being of communities and countries.[3–6] In times of disease outbreaks, researchers generate and communicate information in an effort to support control and prevention strategies in order to improve the well-being of the affected populations.[7]

As we commemorate and reflect on the journey of the *South African Journal of Science* (*SAJS*) since its debut 120 years ago, it is worthwhile to examine what has come through its pages in keeping with its goal of providing information to its readership in South Africa, Africa and beyond. The Journal is multidisciplinary and aims to communicate with a non-expert readership. In this commemorative article, we aim to briefly describe the nature and diversity of articles published in the Journal on selected disease outbreaks of global significance in these past 120 years.

Methodology

To achieve our objective, we used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach. The electronic search was conducted between 30 March and 3 April 2024 to identify Research Articles, Commentaries, Book Reviews and Perspectives, among others, in *SAJS* that reported on a selection of disease outbreaks that triggered interventions of the scale requiring isolation or for which specific treatment was not readily available, and of global significance. Publications on the bubonic plague, Spanish flu, Ebola, acquired immune deficiency syndrome (AIDS), severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS) and coronavirus disease 2019 (COVID-19) were sought. The following search strategy was used: "Pandemic and bubonic plague" OR "Epidemic and bubonic plague"; "Pandemic and spanish flu" OR "Epidemic and Spanish flu"; "Pandemic and Ebola" OR "Epidemic and Ebola"; "Pandemic and AIDS" OR "Epidemic and AIDS" OR "Pandemic and HIV" OR "Epidemic and HIV"; "Pandemic and SARS" OR "Epidemic and SARS"; "Pandemic and MERS" OR "Epidemic and MERS"; and "Pandemic and COVID-19" OR "Epidemic and COVID-19" OR "Pandemic and SARS-CoV-2" OR "Epidemic and SARS-CoV-2". The search, with no time limits, was conducted independently by two researchers.

Search and selection criteria

A total of 267 communications in *SAJS* were identified. Of these, 55 met the inclusion criteria for disease outbreaks for which no specific treatment was readily available or required isolation to control it, and that were of global significance (Figure 1). These communications were used for the narrative.

Narrative

The communications identified were published between 1905 and 2023. A brief overview of the content of the communications is hereby given.

In 1905, Mitchell[8] described the occurrence of **bubonic plague** (the Black Death) in the then Cape Colony of South Africa. The report, on a request from the Editor of *SAJS*, detailed the first cases of bubonic plaque around the ports of Cape Town, Port Elizabeth (now Gqeberha) and East London from 1900, and the subsequent spread of the disease to outlying settlements and to Johannesburg and Pretoria. Also, details are provided on control measures implemented, including isolation of infected persons and contacts; disinfection of ports, homes, merchandise, and sea vessels; inspection of homes and docking ships to eliminate rats and mice; screening and disposal of contaminated merchandise and forage; and inoculation efforts. **Spanish flu** was recounted decades later, in 2020[9], in the form of a Book Review citing other published sources between 1970 and 1980. The review revealed a grim picture of communities facing an illness of unknown origin with little hope of survival for those infected.

A few reports were published between 2014 and 2017 covering several aspects of **Ebola.** For example, a bibliographic analysis revealed that published research on Ebola increased markedly between 1991 and 2013.[10] Information reported included description of the viral genome and determinants for better diagnosis and treatment of the disease. Other articles were aimed at improving public understanding of the origin, control and prevention of

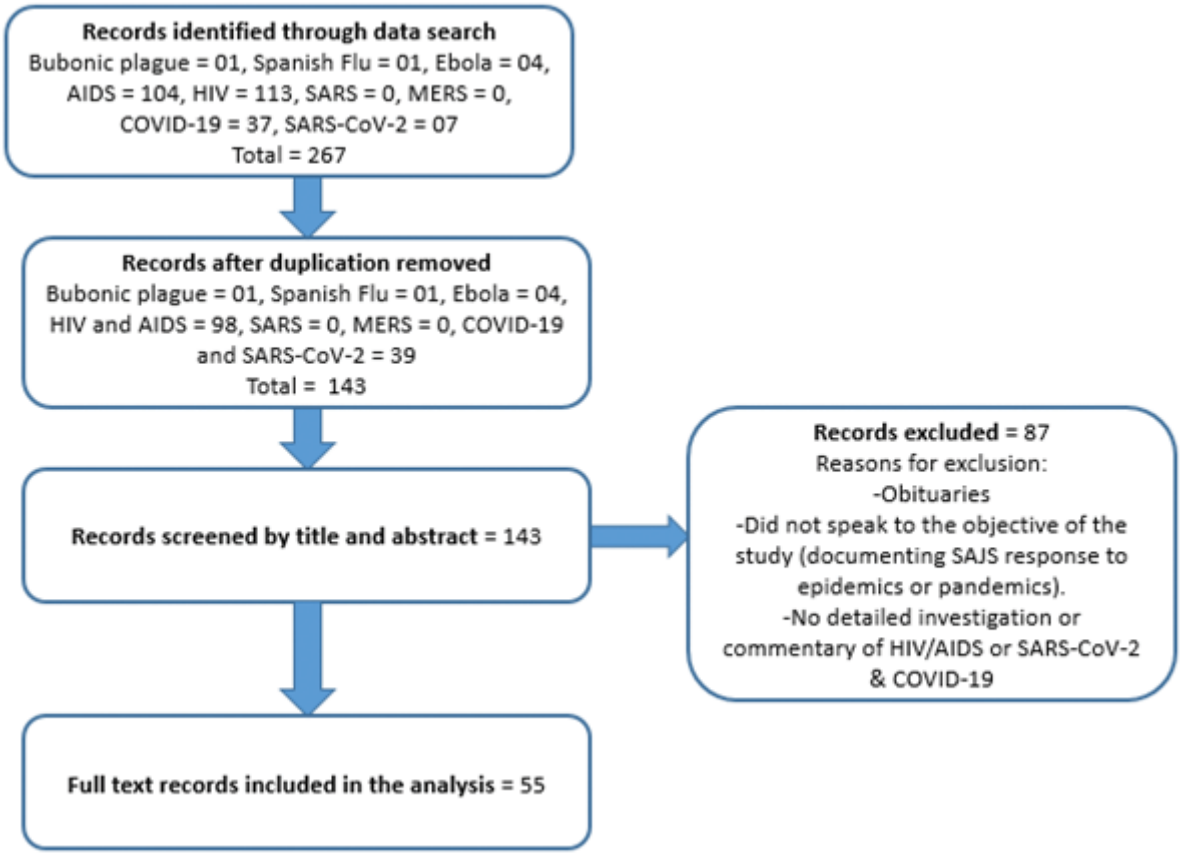

Figure 1: PRISMA flowchart on the screening and selection of studies used for analysis on disease outbreaks of global significance.

Ebola.[11–13] This was in reaction to negative rumours and theories about the true intentions and roles of governments of the Global North and pharmaceutical companies which promoted rejection of the scientific explanation of the origin of Ebola.

HIV/AIDS has featured quite prominently in *SAJS*. This is expected as South Africa continues to have one of the highest prevalence rates of HIV infections[14], with immense human and socio-economic consequences[15,16]. The contributions were in the form of original Research Articles, Research Briefs, News articles, Commentaries and Book Reviews by South African and international authors. Papers on the search for alternative treatments or control measures for HIV/AIDS include the use of medicinal plants such as *Sutherlandia frutescens, Bulbine natalensis* (rooiwortel) and *Hypoxis hemerocallidea* (African potato)[17,18], the use of plant systems to express components for microbicides[19], and contaminants in herbal preparations used by people living with HIV[20,21]. Investigations on repurposing drugs in an effort to clinically manage AIDS were also reported; for example, the screening of a US National Institutes of Health collection for potential inhibitors to HIV integrase.[22] On the relationship between HIV/AIDS and the environment, Kaschula and Shackleton[23] showed that, although the disease negatively impacted poor rural households, there was no correlation between poverty due to HIV/AIDS and increased use of wild animal products.

A Book Review examining conspiracies on the disease addressed fundamental challenges in the understanding of science by the broader society.[24] The review highlighted the undesirable impact that false theories on AIDS have had on the survival of AIDS patients and on populations at risk for HIV acquisition. The denialist policies of the government under former President Thabo Mbeki were brought to the fore. The review explained why these beliefs exist and emphasised the importance for science to succeed in rationally dispelling denialist beliefs and conspiracies.[11,24,25] On the long-term management of HIV/AIDS, *SAJS* communicated on South Africa's contributions to the development of HIV vaccines, and on the initial National Strategic Plan (2007–2011) to address the huge burden of HIV/AIDS infections by accelerating access to treatment.[26,27]

The association of HIV infection and neurocognition is an important mental health issue.[28] A meta-analysis[29] in *SAJS* reported a high prevalence of HIV-associated neurocognitive disorders (HAND) in sub-Saharan Africa and described factors affecting prevalence estimates of HAND. However, it remained to be seen what the impact of HAND would be on daily activities of affected individuals as well as the plausible therapeutic modalities.

The impacts of psychosocial and economic factors, such as stigma, food insecurity and poor adherence to treatment, on the outcomes of HIV testing uptake and progress in achieving the then UNAIDS 90-90-90 targets were also reported.[30,31] On co-infections, a Commentary by Mpaka-Mbatha and colleagues[32] discussed the immunological interaction between helminthic and HIV co-infections, highlighting the need for integrative research in sub-Saharan Africa. Management and translation of large-scale population-based data sets could hold answers to several global health challenges.[33] In this regard, one Perspective[34] described how the population-scale data streams and tools as used in the INFORM-Africa Consortium can be used to plan for future pandemics.

Women's health and HIV also formed part of the Journal's communications. This included the limits of observational epidemiology, and hormonal contraception and women's risk for HIV infection.[35] The relationship between components in HIV treatment regimens and expression of BAX and BCL2 genes in breast cell lines was reported.[36] Other pages highlighted the need for significant participation and retention in order to have reliable outcomes in HIV prevention clinical trials. Related to this, were the reasons for missed visits and strategies to reduce loss to follow-up in clinical trials, to guarantee reliable data sets.[37,38]

The Journal served as an outlet for a variety of contributions on **COVID-19** and SARS-CoV-2, the causative virus. On human communication, no one was prepared for a 'shutdown of communication' due to masks worn over noses and mouths, in the face of a raging virus, which also masked elements required for oral and physical communication.[39] Views on how the virus significantly challenged sustainable development efforts[40], and how the virus diminished moral support provided by families, communities, and religious organisations were expressed.[41] From an economic

perspective, some reports investigated the 'shock' the South African economy suffered and compared it to the consequences experienced during the Spanish flu.[42] The economic vulnerability of shack-dwellers in South Africa compounded the difficulty of residents in these precincts to comply with COVID-19 restrictions, calling for sensitivity to these types of particular situations, and the need for special attention to unemployment among the urban poor, and the long-term outlook on employment.[43,44] During the pandemic, scientists recognised the increased influence the media played in the public and policy spheres, and they reflected on the implications and consequences of a skewed media representation of scientific expertise, as well as some of the options to remedy biased reporting.[45] Inequalities in attaining education brought by the pandemic were discussed. For example, a widening in the gap in the career and life chances of learners with adequate access to personal and educational resources and structures, compared with individuals without these resources.[46] One report shed light on the effect of the COVID-19 outbreak on schooling, especially in resource-constrained areas, and discussed the merits of counselling for career development as an intervention that could bring about transformative change and bring back hope and purpose among students.[47]

Van Wyk and Reddy[48] described how the application of governance systems can give rise to unintended social consequences when the evidence upon which the systems are based is not suitably tailored to meet the needs of specific realities and contexts. Their article highlighted how informality can play a valuable role in fighting a disease outbreak and suggested that, to enhance success, the government should include rather than override informal principles of governance. A case study[49] investigated the precarity of women's academic work and careers during the COVID-19 pandemic. The authors made suggestions for higher education institutions to remedy the negative consequences of the pandemic lockdown on women's academic work and their professional futures.

The strong association of visual, musculoskeletal and developmental impairments and prolonged use of electronic devices during the COVID-19 pandemic and the potential burden on an over-stretched primary healthcare system was also highlighted by Chetty and colleagues[50]. Beyond COVID-19, with the increasing use of electronic devices, the lessons learnt remain valid for the adoption of appropriate measures to minimise the adverse effects of screen time on eye and musculoskeletal health.[50] A Book Review[51] discussed relationships between the COVID-19 outbreak and the political economy within which human health is governed. Recommendations for South African researchers to leverage past investment in HIV vaccine research to understand the immunology of SARS-CoV-2[52,53], and on access and equity to COVID-19 vaccines, diagnostics and treatment options[54], were highlighted.

Several other topics on COVID-19 were published in *SAJS*. Briefly, these included a call for caution in the critical use of predictive models for COVID-19 prevalence[55]; the poor quality of a substantial proportion of hand sanitisers[56]; the lack of COVID-19 vaccine trials in Africa[57]; the connections between COVID-19, global health, and climate change and social medicine[58,59]. In addition to these, views also featured were on the ethics of COVID-19 vaccine mandates post the Omicron variant[60], and the ethics in obtaining electronic consent for research involving humans[61]; cell phone mobility-derived data[62]; and the rise in psychopathologic challenges brought about by COVID-19[63].

Data collection, sharing and use remains a tenuous issue in health emergencies. It was suggested[64,65] that, in the face of different national guidelines, a platform would be required to facilitate the collection, transfer and use of data across the borders of different countries for global health imperatives during health emergencies. Quarantine and restrictions on mobility and potentially confounding factors are historically common in infectious disease outbreaks.[66] Thus, appropriate predictive models can provide guidance for the selection of mobility restriction policies with minimum negative effects on the socio-economic status of communities.[67]

Discussion and conclusion

Disease outbreaks impact human health in several ways and holistic research approaches are therefore necessary to ensure the overall well-being of the affected individuals and communities. This Perspective suggests that the Journal communicated diversely on more recent disease outbreaks of global significance, such as HIV/AIDS and COVID-19, than on earlier ones such as Spanish flu, bubonic plague, SARS and MERS. This could probably be attributed to a combination of factors. First, the infancy, and the very small scientific research community in the early decades of the Journal's existence. The single report on bubonic plague in *SAJS* in 1905 by Dr Mitchell[8], which was submitted by invitation, may be a reflection of the situation then. Second, the pursuit of higher education training and scientific investigation has not always been open to all in South Africa, with devastating consequences for human capital development for the majority non-white population and the country as a whole.[68–70] The political dispensation, post-1994, ushered in a period of improved access to training and skills acquisition in biomedical and clinical research to all demographic strata of the society. This trend has continued, albeit with teething challenges emanating, to a substantial extent, from the segregation and apartheid laws of the past.[71,72] In this regard, the Journal is now receiving submissions on research findings and opinions from a much more diverse group of researchers. Third, the threats to South Africa and Africa from disease outbreaks such as SARS and MERS were minimal compared with those from HIV/AIDS and COVID-19. It appears that local immediate relevance is an important trigger for scientific enquiry. For example, prior to COVID-19, very little research on coronaviruses took place in Africa.[73] Fourth, *SAJS* is one of several journals in South Africa and southern Africa that researchers may choose as an outlet for their research findings. This includes journals that are more medically focused.

The present Perspective is by no means exhaustive. It does not cover other diseases of public health importance for South Africa and Africa such as tuberculosis, smallpox, measles, and cholera. Nevertheless, this brief narrative on what *SAJS* has communicated on a selection of disease outbreaks of global importance over the decades demonstrates the Journal's increasing interest and commitment in informing its broad readership on research and perspectives on disease outbreaks of global significance. In addition, it would be of interest to understand the extent to which the apartheid system influenced the editorial policy of *SAJS,* and by extension, what the Journal published then on health matters for the benefit of the greater society. Currently, there is appreciation of the need for preparation in order to prevent or respond to future global disease outbreaks.[74] We are of the view that the same desire should be applied to potential disease outbreaks of a national or regional nature. In this regard, *SAJS* can play a significant role in keeping this desire alive by issuing periodic calls for research findings and opinions on emerging and re-emerging pathogens and their potential to cause outbreaks, both in the country and on the African continent.

Declarations

P.O.B. is the *SAJS* Associate Editor and M.J.R. is the *SAJS* Associate Editor Mentee for Cell, Molecular and Health Sciences. P.O.B. receives funding for antimicrobial resistance and global health research from the South African Medical Research Council. There is no AI or LLM use to declare. The opinions expressed herein are those of the authors and are not necessarily the views of their affiliations or funders.

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Growth of the chemistry discipline over the last 120 years, as documented by the *SAJS*

Significance:

This article demonstrates how *SAJS* has played a significant role in validating and documenting scientific breakthroughs in chemistry, among other disciplines. As a central discipline, chemistry has contributed to economic and industrial growth in manufacturing, mining, health, food, water, energy and other industry sectors. The discipline supports the implementation of nearly 12 of the 17 United Nation's Sustainable Development Goals 2030. Chemistry, through research and innovation, will continue to play a significant role in responding to emerging technologies that drive industrial revolution, with artificial intelligence as one of the enablers.

Introduction

The economic and industrial development of South Africa has relied on science, technology and innovation advancement, as informed by research. In the last 120 years, the *South African Journal of Science* (*SAJS*) has provided researchers in most disciplines, including the chemistry field, a platform to disseminate their findings, share discoveries, and contribute to the collective body of knowledge. Chemistry is a central discipline that underpins the physical, material, and biological world, and it finds application across multiple fields, including manufacturing, mining, health, food, water, energy, and other industrial processes. In a formal sense, chemistry is traditionally divided into five major sub-disciplines: organic, biochemistry, inorganic, analytical, and physical. However, it is projected that chemistry will continue to grow into a multidisciplinary field, resonating with the Journal's scope. We note that a significant contribution to South Africa's industrial processes involves chemical research. In this article, we discuss the historical perspectives of *SAJS* and its contribution to the growth of the chemistry discipline and how this growth has impacted the industrial, socio-economic and environmental sustainability of the country. The key aspects covered in this article include the growth of the chemical industry in South Africa since 1900, and the role of chemistry in achieving the Sustainable Development Goals (SDGs). Other aspects include the contribution of the discipline to emerging technologies, including their interplay with artificial intelligence to drive the Industrial Revolution.

Historical perspectives: The role of *SAJS* in promoting chemistry

SAJS publishes studies in life sciences, social sciences, physical sciences and technology. It covers a wide range of cross-cutting topical issues, including research ethics, social media, academic integrity, theology, burden of disease, and higher education, as well as water, energy and climate change, among other issues. The Journal archive runs from Volume 1 Issue 1 January 1905 to the most recent issue, 120 Issue 9/10 September 2024.[1] The Journal was established in 1903 as a Proceedings of the Annual Meetings of the South African Association for the Advancement of Science (S_2A_3).[1]

One of the first articles in *SAJS,* authored by Cunningham in 1905[2] and entitled 'Unconscious Assumptions in Economics', discussed economic and industrial developmental issues affecting South Africa at that time. In another article by S. Kidd in 1905[2], entitled 'The study of economics in South Africa', the author underscores the importance of teaching the subject of economics at the bachelor's degree level. An article by Sutherland in 1905[3] entitled 'Some statistics of the mineral industry of the Transvaal' discussed industrial processes involving the output of gold, silver, coal and diamonds. These examples serve to illustrate the diversity of the subject fields covered by *SAJS*, based on the few selected publications in the early days of the Journal. Academic journals provide access to knowledge and act as vehicles for sharing research outcomes with the global scientific community. They provide researchers with a platform to disseminate their findings, share discoveries, and contribute to the collective body of knowledge.[4] The *SAJS* has therefore documented the country's evolution of scientific discoveries as well as the economic and Industrial Revolutions of the 20th and 21st centuries.[1]

We selected several publications of the Journal in the field of chemistry in the 20th century to highlight the growth of the discipline. 'Modern chemistry', authored by Green in 1919[5], discussed the concept of modern chemistry. The author commented on the broadness, enormity and complexity of the chemistry field "for a human mind to comprehend". Another article by Rose (1929)[6] entitled 'Alcohol mixtures as motor fuels in South Africa', discussed the use of alcohol as a liquid fuel to supplement petrol shortages or "abnormal rises in petrol price". A few other articles in chemistry that were published in the early 20th century include 'The occurrence of sodium nitrate in South-West Africa' by Thomas (1929)[7] and 'On the laboratory methods available for examination of the physical nature of soil: A discussion and selected reviews' by Coutts (1929)[8]. The latter is one of the few articles in the early years of the Journal's existence that reported a laboratory investigation of soil analysis, in which the procedures involved the determination of physical-chemical parameters following sample preparation and extraction of the target components. Coutts[8] demonstrated typical chemistry methodologies as we know them in present-day research.

The above examples of selected chemistry articles serve to highlight the importance of the chemistry discipline during South Africa's economic, environmental and industrial growth since the 20th century. However, we opine that the articles published in the early years of the Journal were very broad and shallow in content as the authors reported limited experimental methodological procedures compared to today's chemistry structure and methodology

as we know them. It is our opinion that the Journal has been instrumental in promoting the visibility and impact of the South African research community and that of the continent, in various sectors. As indicated above, *SAJS* is a "multidisciplinary journal on African-relevant issues of interest to readers in various disciplines and for the benefit of scholars, educators, policymakers and the general public"[1]. The Journal, through its publications, has documented the impact of the Industrial Revolutions[9] (IRs) from the 20th century to date. Historically, "South Africa's science has a long and proud tradition, born in the mid-18th century from the works of amateur natural historians and astronomers who travelled to the Cape Colony at that time, to satisfy their intellectual curiosity", as reported by Mouton and Gevers[10].

During the 21st century, the 4IR[11] has benefited tremendously from artificial intelligence (AI), which has seamlessly integrated itself into various sectors, enhancing efficiency, streamlining processes, and ultimately paving the way for a brighter future as we move to the 5IR. Ziatdinov et al.[12] indicated that the 5IR is a "transformational point in human history, where the harmonization of human and machine intelligence emerges as the imperative, for the advancement of humanity". Chemistry as a central science, no doubt, has contributed to the technological development that led to the Industrial Revolution, particularly advanced material chemistry research and innovations[13] which have led to products that have played a steering role in earlier Industrial Revolutions[14]. Chemical processes have played a significant role in South Africa, as reported by Majozi and Veldhuizen[15], in establishing industries such as oil refineries, mining, chemicals, manufacturing (paper, steel, plastic, glass, etc.), water and electricity. Furthermore, advanced material chemistry is currently a prominent enabler of the 4IR through developmental innovations such as "new smart materials (organic light-emitting diodes, optical fibres and carbon nanotubes), used in communication technology and nanochip technology", as reported by Malik et al.[16]

Growth of the chemical industry in South Africa since 1900

In South Africa, the main chemical industries include speciality chemicals, organic and inorganic chemicals, pharmaceuticals, polymers and rubbers, fine chemicals, plastics products, consumer chemicals, liquid fuels, and others. Both liquid fuels and plastic products contribute about 50% to the chemical industry, as reported by Majozi and Veldhuizen[15]. South Africa's industrial research and development has been closely linked to the establishment of the earlier three key organisations which are still part of the macro-industrial landscape, namely the Iron and Steel Corporation (Iscor, now Mittal Steel South Africa), the Electricity Supply Commission (Eskom) and the Industrial Development Corporation (IDC). The Council for Scientific and Industrial Research (CSIR), established in 1945, played a major role in promoting and carrying out cutting-edge scientific research, and, through its influence, ultimately ensured a wider appreciation of the developmental role of scientific research within the country.[10] Sasol, on the other hand, was established as a state-owned chemical and energy company known as the South African Coal, Oil and Gas Corporation in 1950 in Sasolburg[17], and produced chemicals and petrochemical products. *SAJS* has played a key role in documenting some of the scientific breakthroughs from industrial research in peer-reviewed articles, which remain the major vehicle by which research findings are validated and scientists obtain credit for their contributions.

Scientists in South Africa in the early 20th century made significant contributions to industrial chemical research. For example, Dr James Moir (1902–1925) played a major role as one of the pioneering chemists in the early 1900s.[18] Dr Moir was mainly an organic chemist but made a significant contribution in the field of inorganic chemistry. His research investigated gold extraction, employing products such as thiourea for removal of cyanide using ferrous sulfate. He investigated the 'Purple of Cassius', a purple pigment formed by the reaction of gold salts with tin(II) chloride. This chemical has been used to impart glass with a red colouration, as well as to determine the presence of gold as a chemical test. "Dr Moir was also a theoretical chemist who played a role in the development of atomic theory and made suggestions to help unravel the nature of the atom, the composition of the nucleus and chemical combination", as reported by Loyson[18].

The mining sector is one of the oldest industries in South Africa that has benefitted from chemical sciences research. According to the World Bank[19], mining has contributed significantly to South Africa's economic growth and employment, owing to its mineral resources, including the platinum group metals, gold, iron ore, and manganese. The mining sector has been a strong incentive for investing in research in the field of chemical sciences in South Africa, as reported by Mouton[20].

To demonstrate how chemical sciences have positively impacted South Africa's industrial and economic growth, we briefly discuss the contribution of Sasol and Eskom. The former produces synthetic fuels and chemicals as the core products. In addition, Sasol[17] serves various industries including agriculture, automotive and transport, building and construction, consumer goods, flavours and fragrances, health and wellness, home care, industrial and institutional cleaning, inorganic materials and catalysts, manufacturing and industrial, mining, oil and gas, paper and water, packaging, printing and coatings, personal care, polymers, textile and leather. "The fuel products, which include petrol, diesel, jet fuel, illuminating paraffin, fuel oil, bitumen and liquefied petroleum gas, contribute about 8.5% to South Africa's GDP and supplies around 18% of the country's primary energy", as reported by Johnson, the Business Development Executive of Adcorp BLU company.[21]

Another important industry in South Africa is that of coal[22] which provides the primary energy needs for electricity generation, petrochemicals and steel production. Chemistry processes are involved in the coal preparation and beneficiation using acids and bases to remove impurities. Coal is composed of nitrogen, oxygen, carbon (50–98%), ash (which contains silica, alumina, iron oxide, and calcium), sulfur, hydrogen (3–13%), water and particles of inorganic matter.[22]

Chemistry and the Sustainable Development Goals

The chemistry enterprise offers opportunities in technology, the economy, and human health, and there are many ways in which chemists are working to support global sustainable development. The American Chemical Society[23] has identified seven priority SDGs: #2 Zero Hunger, #3 Good Health & Well-Being, #6 Clean Water, #7 Affordable & Clean Energy, #9 Industry, Innovation & Infrastructure, #12 Responsible Consumption & Production, and #13 Climate Action. There are five additional SDGs[24] that are foundational to the work of the chemistry community. These are SDG #5 that supports gender equality by empowering all women and girls through chemical education and skills development, #10 reducing inequality by providing equal access to opportunities, #11 making cities and human settlements inclusive, safe, resilient and sustainable by producing quality building materials, #14 supporting conservation and use of the oceans, seas and marine resources for society's benefits, and #15 protecting and restoring use of terrestrial ecosystems.

To give an example of the applications of chemistry in the SDGs, we have looked at the analytical chemistry subdiscipline. This is a multidisciplinary branch of chemistry that cuts across many science disciplines. Oliveira[25] highlighted the applications of analytical chemistry, including quality control of food, emerging microplastics pollution, nanoparticle and single particle determination, the control and removal of toxic elements and substances from environmental systems (water, soil, and air), and all chemical hazards that societies are exposed to today, which need attention and control.

Chemistry and emerging technologies for the Industrial Revolution

The advancement of technologies during the First to Fourth Industrial Revolutions (1IR to 4IR)[9] has seen the emergence of new fields such as nanotechnology which draws significantly from material chemistry[13].

The emergence of 4IR was characterised by technological advances in different fields, including faster computer processing, big data analytics, artificial intelligence (AI), robotics, 3D printing, blockchain, nanotechnology, biotechnology, Internet of Things (IoT), virtual reality (VR) and augmented reality (AR), etc.[26]

In this section, we have chosen nanotechnology and nanoscience as an example to illustrate the role that chemistry has played in the Industrial Revolution. We note that nanotechnology is listed as one of the enablers of 4IR as reported by Mouton[20]. Nanotechnology is the science of designing, producing, and applying structures and devices having one or more dimensions of about 1–100 nanometres.[27] This field has allowed interactions and collaboration with other disciplines such as engineering and medicine. Applications of nanochemistry include medicine, cosmetics, sensors, catalysis, textiles, automotive industry, structure and engineering, defence and medical applications such as magnetic resonance imaging detection (MDR), drug delivery, tissue engineering, enzyme reactions, nanowire compositions, energy, and water treatment, among other sectors.[27] We chose to discuss nanotechnology as an example, to highlight the role of emerging fields in shaping the direction of academic disciplines.

In our opinion, nanotechnology has contributed to the multidisciplinarity of the chemistry discipline in which a significant number of researchers (including the authors of this article) in chemical, biological, physics and engineering sciences in South African universities and research centres are publishing.

Chemistry research themes in South African institutions

Scientists from universities and research institutions in South Africa are the main contributors to *SAJS* publications. Our brief survey of *SAJS* publications shows that researchers in chemical sciences in most of the South African institutions of higher education are publishing authoritative research on all branches of chemistry, including organic, inorganic, solid-state, catalysis, analytical, physical, material science, nanoscience, and chemistry education. This section reports a brief survey of selected universities in South Africa, to highlight the teaching and research areas conducted by the chemical sciences departments. In our opinion, publications in *SAJS,* to some extent, reflect the teaching and research thematic areas in universities and research institutions. It is for this reason that we found it necessary to do a brief survey of teaching and research thematic areas in chemistry in selected universities in South Africa, to highlight the interlink between teaching and research, and publications in *SAJS* in the chemistry discipline.

In order to establish the thematic areas of teaching and research in South African universities, we selected a few universities: the Universities of Johannesburg[28], Witwatersrand[29], Cape Town[30], Stellenbosch[31], KwaZulu-Natal[32], Pretoria[33], Venda[34], Zululand[35] and Walter Sisulu[36]. We visited their websites to determine their teaching and research themes. We established that some of these universities offer teaching courses in traditional areas of chemistry, namely, analytical, inorganic, organic and physical chemistry. In some of the universities, the teaching courses were broad and included special topics that mirrored the research themes. Generally, the spread of research programmes differs significantly between universities.

As indicated in the previous section, *SAJS* publishes work from South African researchers as well as from outside the country, mainly from the continent[37] as well as chemistry publications authored by researchers from non-chemistry departments[38]. A spot-check of some articles shows collaborative and multidisciplinary research in health sciences, biotechnology and engineering fields.[39] Applied research is also evident from some of the publications in the medical field, energy, waste management, and climate issues, to mention a few.[40]

Conclusions: The future of the chemistry discipline

The *SAJS* has contributed to science development in South Africa by documenting the country's evolution of scientific discoveries, as well as the economic and Industrial Revolutions through the 20th and 21st centuries. The Journal has promoted the growth of the chemistry discipline by disseminating findings by researchers from different institutions, which have played a significant role in the country's industrial processes. The chemistry discipline, as we know it today, has shown growth since the 17th and 18th centuries when the subject field was at alchemy level.[41] In this paper, we have presented historical perspectives of the Journal by highlighting how the chemical industry in South Africa has grown since 1900. Chemistry has contributed to emerging technologies and Industrial Revolutions, as well as the implementation of SDGs.

We opine that *SAJS* will not only continue to play the fundamental role of a repository of science knowledge but also the critical review process which has influenced the increasing complexity and the multidisciplinarity of research fields including chemistry, so as to meet the demands of our global scientific community.

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Declarations

J.C.N. is on the *SAJS* Editorial Advisory Board. There are no competing interests to declare. There is no AI or LLM use to declare. Both authors read and approved the final version.

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120 Years of earth and environmental sciences in the *South African Journal of Science*

Significance:

During the 120 years in which the *South African Journal of Science* (*SAJS*) has been published, a number of important environmental milestones have occurred in South Africa and globally. The Journal has included passing commentary on many of these events, while specific events such as the inception of the Working for Water Programme have been the focus of numerous papers. The Journal has consistently reflected the key issues of the time. In recent years, the portfolio of Earth and Environmental Sciences has been dominated by submissions on water quality and climate change, in addition to geology, conservation, environmental policy and planning, waste management, and environmental health.

Introduction

The *South African Journal of Science* (*SAJS*) has, since its inception, been inherently interdisciplinary. There are therefore no explicit nor distinct thematic boundaries in the publication of material, although discipline-specific experts are appointed as Associate Editors to assist the Editor-in-Chief in soliciting peer reviewers and making final decisions on acceptance for publication. Earth and Environmental Sciences is one of 10 portfolios to which Associate Editors have been appointed in recent years. Given that many of the contemporary global polycrises intersect with earth and environmental sciences, it is unsurprising this portfolio receives among the greatest numbers of submissions to the Journal.

Earth and environmental sciences over the past 120 years

The first volume of the *SAJS* was published on 01 January 1905.[1,2] The first article in this volume was a paper by David Gill[1] on astronomy, while the rest of the volume was composed of papers on topics including astronomy, mathematical equations, metallurgy, and meteorological notes from weather stations.[2] The latter two would form part of what today is handled by the Associate Editor for Earth and Environmental Sciences, although in both domains research has become significantly more applied over the decades.[3,4] Concurrent with the publication of research in the Journal over the past 120 years, a number of key environmental events occurred in South Africa and abroad, with local impact that has continued to the present day (Figure 1).

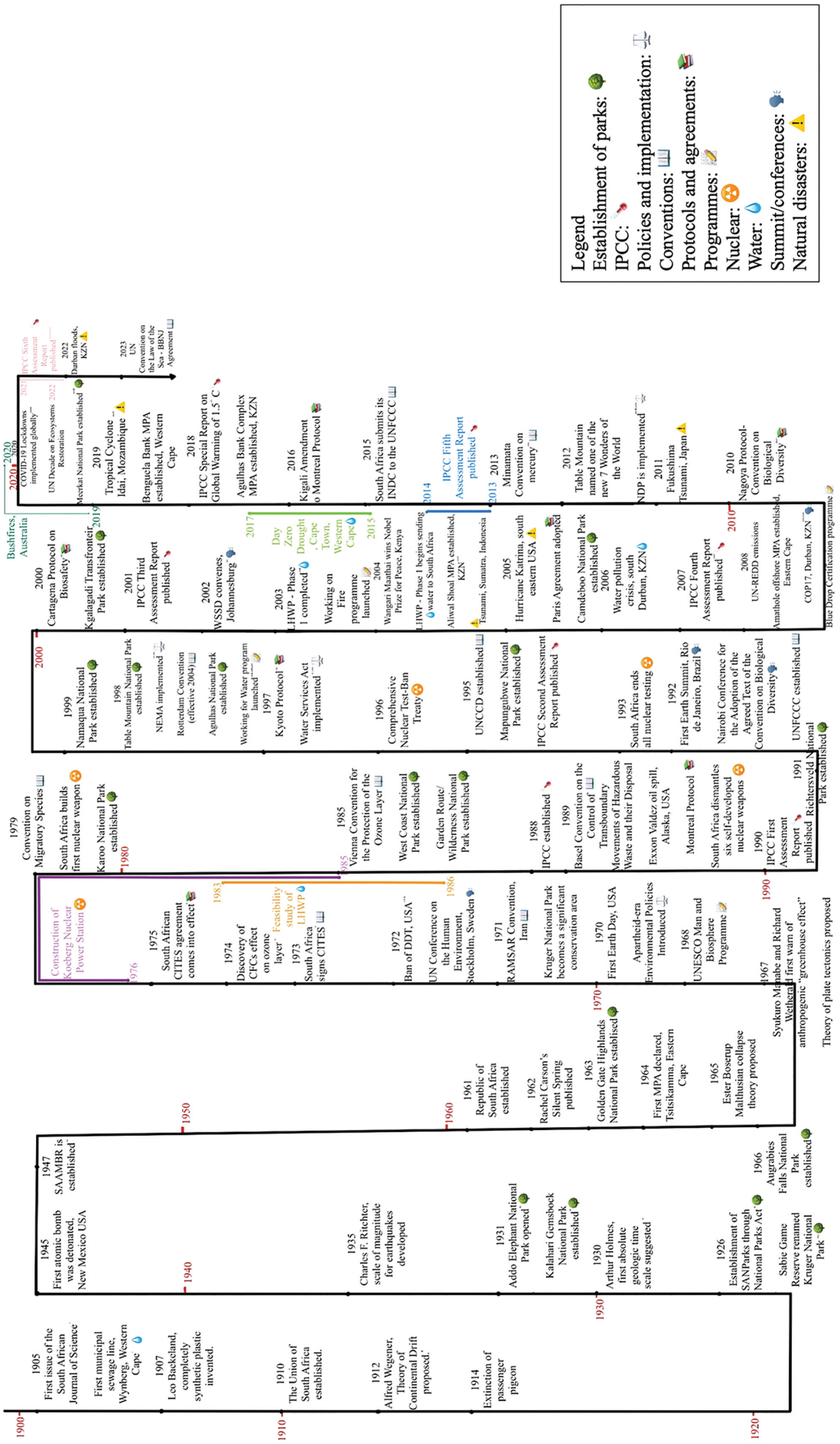
Many of the environmental events in the earlier portion of the timeline were not directly discussed in papers published in the *SAJS*. There is a gap in global and local noteworthy environmental events between 1947 and 1961 (Figure 1). While scientific discovery did not halt in the 1950s, the main discoveries were medical, including the beginnings of heart transplant research[39], blood testing for tuberculosis, invention of full body X-ray and dialysis machines[40], and the first kidney transplant[39]. Direct discussion in papers published in the *SAJS* on environmental events has increased in recent decades (Figure 1). The Working for Water Programme, launched in 1998, was covered across three papers examining the launch and implementation of the Programme in 2004.[20–22] The 100th volume of the *SAJS*, published in 2004, covered the various aspects of the inaugural research symposium of the Working for Water Programme, held in 2003, and thus included a wealth of research examining the Programme and its implementation. Global events, such as the ban on DDT, and the discovery of the impact of CFCs on the ozone layer, have also been the topic of direct coverage in articles in the *SAJS* (Figure 1).

The timeline presented in Figure 1 highlights the thematic trends which have been the focus of earth and environmental science research in the *SAJS* throughout the past 120 years. The categories of events which are most included in the timeline include the establishment of national parks; the publishing of IPCC reports; the occurrence of natural and anthropogenic disasters; the implementation of environmental programmes, policies, protocols, and agreements; developments related to water management and nuclear power; and the hosting of significant conferences and summits. The events which can be considered to be significant environmental events affecting South Africa are thus varied in their characteristics, but all reflect critical components of the South African environment, and provide a through line with which to examine the evolution of earth and environmental science research in the *SAJS* over the past 120 years.

Submissions in recent years

Over the period 2017–2023, Earth and Environmental Sciences has been one of the largest of the 10 current portfolios and thematic areas in the *SAJS* (Table 1).

Over the period April 2021 to May 2024, the period of the term to date of the current Associate Editor, a total of 106 submissions to the *SAJS* have been allocated to the Earth and Environmental Sciences portfolio. This number slightly underrepresents the total number of submissions within this domain, as where there are potential conflicts of interest, journal policy mandates that those submissions are handled by another Associate Editor, who works reasonably closely to the field of interest. This approach is important in a large journal such as the *SAJS*, to enable authors who work closely with members of the editorial team to submit their papers to the Journal, while ensuring a high standard of editorial practice whereby peer review and editorial decisions are not influenced by personal bias and favour. A key example here is the work of Kruger et al.[41], for which the second and third authors were both supervised by the Associate Editor for Earth and Environmental Sciences. Although the paper 'AgERA5 representation of seasonal mean and extreme temperatures in the Northern Cape, South Africa' clearly falls within



Data sources:[1,5–38]

Figure 1: Timeline depicting the major earth and environmental science events documented in the *SAJS* over the past 120 years.

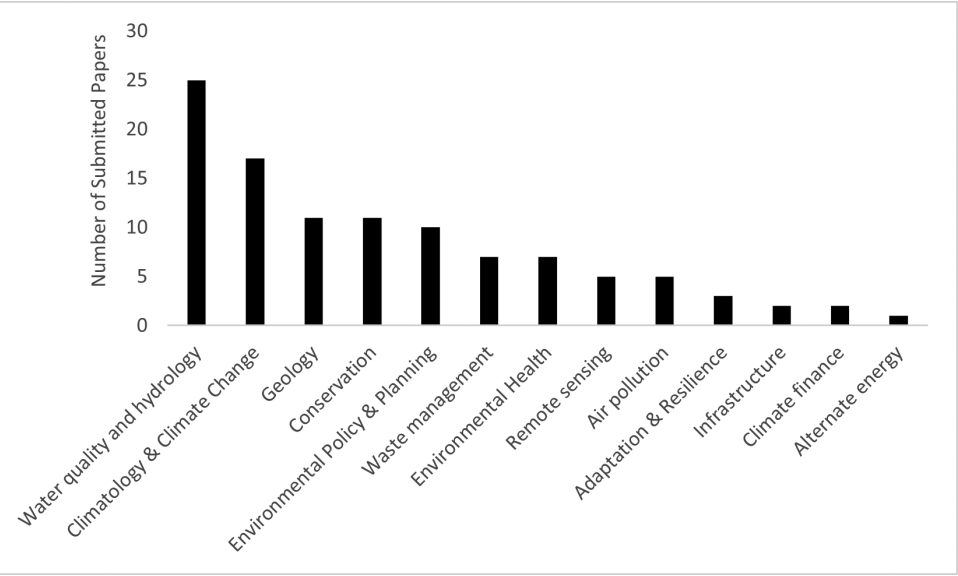


Figure 2: Submissions to the *SAJS* between April 2021 and May 2024 that were allocated to the Earth and Environmental Sciences portfolio.

Table 1: Percentage of submissions to the *South African Journal of Science* allocated to the Earth and Environmental Sciences portfolio

Year	Percentage
2017	24%
2018	17%
2019	11%
2020	17%
2021	9%
2022	13%
2023	19%

the domain of Earth and Environmental Sciences, this submission was handled by the Associate Editor for Archaeology, Anthropology and Palaeontology.

These few exceptions do not, however, skew the patterns in the subject matter of the submitted manuscripts (Figure 2). The largest proportion (23.6%) of papers submitted over the past three years has been in the field of water science, including research exploring water quality, water availability, hydroclimates and hydrology (Figure 2). This is followed by research on climatology and climate change research (16%), which has been a particular area of focus with the concurrent release of the IPCC 6th Assessment Report[37,38], and a range of climate crises across the southern African region, including the Cape Town Day Zero Drought[42] and Tropical Cyclone Idai[34] (Figure 2). This is followed by relatively equal proportions of submissions on geology, conservation, and environmental policy and practice (Figure 2). Emerging topics in climate finance[43] and recent engagement with renewable energy[44] with a focus on the Just Energy Transition are included among the less frequent submissions to the Journal (Figure 2). While not all submitted papers go on to be published, these broad patterns in disciplinary focus remain within the published outputs.

Looking forward

In the next 120 years, the importance of scientific research on the earth and environment is likely to increase. Climate change projections indicate regional temperature increases that are considerably higher than the global mean, while extreme climate events are likely to occur more frequently, and with greater severity. Continued urbanisation is projected to place an increasing pressure on our water availability, air quality, and biodiversity. The interdisciplinary nature of the *SAJS*, and the space offered for commentary pieces, perspectives and book reviews, allows for a range of voices to continue to contribute to important debates. It is likely that the Journal will remain a popular choice for researchers working in this domain.

Declarations

J.M.F. is the *SAJS* Associate Editor for Earth and Environmental Sciences. There are no competing interests to declare. There is no AI or LLM use to declare. All authors read and approved the final manuscript.

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What have we been thinking about? Higher education as a knowledge field in the *SAJS*

Significance:

This article reviews work published in the *South African Journal of Science* (*SAJS*) over the past 10 years. The aim is to explore the interests of contributors who mostly are not experts in higher education but whose disciplinary backgrounds and experiences of universities lead them to research, think and write about higher education. The article begins with an outline of changes in higher education globally and in South Africa before moving on to a review of work published by the *SAJS*, identified as the result of a content analysis.

Introduction

The development of higher education as a field of research can be related to changes in higher education systems across the world in the last 80 years or so. From the end of World War II onwards, higher education systems in countries in the Global North began to 'massify', a process which began with nations such as the United States of America and the United Kingdom opening up their universities to those returning from service in World War II. As Trow[1] points out in his seminal report for the Carnegie Commission on growth in higher education systems, massification has enormous implications for universities themselves. The larger the higher education system, the greater the demands on the public purse. As this happens, universities come under the scrutiny of a larger number of people, both in government and society more generally, who ask questions about where, and how, money is being spent. The relationship to the state shifts when increased funding for universities comes from the public coffers and, as a result, challenges to institutional autonomy and academic freedom become increasingly common.

The dominance of neo-liberal discourses has also had important consequences for higher education across the world[2,3], especially when associated with the construction of knowledge as a commodity to be bought and sold. The idea that universities can earn income from the production of knowledge and that students will earn increased incomes as a result of the knowledge they carry into the workplace has allowed governments across the world to justify decreases in funding for universities and increases in tuition fees – a phenomenon which resulted in the #FeesMustFall protests of 2015 and 2016 in South Africa. Neo-liberalism along with massification then impacts on the way universities are run. Historically, academics were once expected to play a number of different roles in order to ensure sound governance and administration of the university at which they were employed by, for example, serving a period as dean of a faculty, or even as registrar. As institutions have grown in size and complexity, the functions previously performed by academics have been taken over by professional 'managers', a process hastened by the introduction of 'New Public Management' to higher education. The concept of 'New Public Management', which gained traction from the late 1970s onwards thanks to the support of politicians such as Margaret Thatcher and Ronald Reagan, argues that public service can be made more efficient and cost-effective by drawing on models of management from commerce and industry, an observation that speaks to concerns about the increasing sum of taxpayers' money needed to fund the universities. Practices associated with New Public Management generally involve the identification of goals, strategies and key performance indicators in every area of academic life. Discursively, this has involved a shift from the idea that universities need to be 'administered' by academics taking up senior roles, to their need to be 'managed' by 'professionals' who may have very little experience of academic life and who might not have the respect of their colleagues as intellectuals and researchers. At a practical level, it has also resulted in the introduction of a new level of management taking the form of, for example, quality assurance offices and institutional planning units. This has not only increased the number of administrative staff working in universities but has also edged academics out of the governance and management of the institutions in which they work. Ironically, the sums spent on 'managing' a university then stretches institutional resources to the limit, leading to resentment from academics who feel that teaching, research and other activities contributing to the academic project are underfunded.[4,5]

However, it is not only on governance and administration that growth in a higher education system has an impact. Trow[1] points out that growth also affects the way 'newcomers' are socialised into university life. As new academics are recruited to teach ever-increasing numbers of students, they come to shape academic life and values within departments and faculties. Growth in the number of postgraduate students means that traditional one-on-one supervision shifts to group models with the result that student culture becomes the "chief socializing force of the new postgraduate students with consequences for the intellectual and academic life of the institution"[1(p.2)].

Students in massified higher education systems also come to see enrolment in a university differently, according to Trow[1(p.7)]. In elite systems, where only a small proportion of 18 year olds enter a university, higher education tends to be seen as a privilege. As the proportion of young people in higher education grows, access is increasingly seen as a right and, eventually, as an obligation, as finding employment without a qualification becomes ever more difficult. Once this happens, understandings of the functions of universities themselves shift with a higher education becoming less about developing the mind and more about training for employment. The curriculum is then impacted. Whereas traditional curricula tended to draw on the disciplines, they are now often modular in structure and draw on organising principles such as learning outcomes, with Wheelahan[6] pointing to the 'knowledge poverty' that results. In a traditional curriculum, disciplinary knowledge is built cumulatively. In a modular outcomes- or problem-based curriculum, only the knowledge needed to perform the outcomes is included, with the result that understanding of the overall knowledge structure is incomplete. This has implications for the way universities are structured as, in some cases, traditional departments based on the disciplines disappear to be replaced by schools

or other arrangements to suit the offering of programmes drawing on knowledge from a range of disciplines, with concomitant effects on the intellectual lives of those employed in them.

The South African system

South Africa, of course, has not been immune from the enormous change that has affected higher education systems across the world, although the history of the country means that imperatives have been, and remain, different. As South Africa shifted to democracy in the early 1990s, the idea that growth in the higher education system would lead to greater equity was dominant in policy documents[7,8] of the time.

Trow argues that higher education systems appear to be able to expand without changing fundamentally when enrolments are below 15% of the age cohort. Once a participation rate of 15% is achieved, change occurs. The Council on Higher Education[9] (CHE) reports the overall participation rate as 24% for 2021, the latest year for which data are available, although participation continues to be skewed across social groups, with 48% of white young people entering universities in comparison to 23% of their black peers. Not only does South Africa have a skewed participation rate, it also has a much lower rate than countries in the Global North. In the United Kingdom, for example, the participation rate peaked at 38.2% in 2021 and is now standing at about 35.8%.[10] Nonetheless, the South African system has more or less doubled in size since the early 1990s in terms of gross student enrolments, although increases in enrolments have not necessarily brought the benefits initially envisaged. While some small improvements have been achieved in recent years, analyses (in the form of the CHE's *VitalStats* series published annually) consistently show that, regardless of the university at which they are registered, the subject area or the study or the qualification for which they are enrolled, black South African students fare less well than their white peers.

In 2001, the National Plan for Higher Education[11] attempted to address disparities in the system in the form of the distinction between historically black and historically white institutions and between technikons and universities, as well as differences in the language of instruction, by instituting a series of mergers and incorporations. The institutional type of the 'university of technology' emerged at this point, reflecting the construction of higher education as involving preparation for the world of work. As some point out (see for example Dwayi[12]), historically white universities such as Rhodes University and the University of Cape Town were spared in this process, while institutions such as the University of the Transkei were forced to merge with and incorporate disparate institutions located over wide areas, leaving the new institution very difficult to manage. Cooper's[13] observation that historically black rural universities such as the University of Zululand and the University of Venda continue to enrol mainly the black rural poor is arguably still true today, with Dwayi[12,13] pointing out that Walter Sisulu University is the only destination possible for most young people from rural areas in the former Transkei. What would appear to be the case, therefore, and a point also noted by Cooper[13], is that the majority of black students entering historically elite institutions are from middle-class, educated backgrounds.

This point is born out globally, with observers[5,14,15] noting that the greatest single indicator of a young person's ability to gain access to and succeed in a university is the educational level of the home of origin. A wealth of ethnographic research[3,16-18], spanning many decades of study, shows why this is the case. The observation that the educational background of the home of origin has enormous impact on a young person's ability to access and succeed in higher education explains data showing that black South Africans fare less well in the universities noted above. That black families were historically denied access to quality education because of apartheid and dysfunction since 1994, means that the school system continues to fail them. As a result, there is little "educational capital" to support black learners in preparing them for schooling and then supporting them in it.[19]

Goals in the National Development Plan 2030[20], linked to changes at a global level associated with the so-called 'knowledge economy', also have implications for the university. The National Development Plan targets an increase in the number of doctoral graduates to 5000 per year, up from 1256 in 2012, the year it was published. By and large, universities have responded to incentives to produce more doctoral graduates, with CHE reporting a total enrolment of 24 725 doctoral candidates in the system in 2021 – up from 9573 in 2016. As many readers of this Journal who supervise at this level will have already noted, for many candidates, the doctorate is a route to employment, an observation that impacts on the way doctoral students may approach their studies.

Concerns about the quality of doctoral degrees resulted in a national review of doctoral programmes conducted by the CHE from 2020 to 2021.[19] The review raised a number of problems, one of which is related to the use of the concept of 'graduate attributes' in a standard setting. The CHE is currently producing 'standards' for all South African qualifications drawing on this notion. The principle is that universities should use the standards, and therefore the attributes they list, to design programmes leading to the qualifications they describe. The National Review, however, identified "a surprising lack of awareness, or depth of understanding among many academic role players of the attributes that a doctoral graduate should attain"[21]. Attributes describe the 'doctor' and can thus be linked to Trafford and Lesham's[22] concept of 'doctorateness'. Their use in the qualification standard has implications for supervision as the focus needs to be on the development of the person. It is at this point that the incentivised funding formula[23] has an impact because of the emphasis in many universities for completion in "minimum time" to gain maximum financial benefits. As many experienced supervisors will note, it is often easier to focus on the completion of the thesis than the development of the person, which takes time, leaving open the question of whether graduates are demonstrating the "doctorateness" captured in the standard.[21] A second point related to the use of graduate attributes involves assessment, because attributes arguably require more than the use of a thesis to demonstrate. Increasingly, universities require graduates to publish their work as evidence of their original and innovative thinking and contribution to knowledge, although this is not necessarily evidence of their intellectual growth and depth.[21] For some[24], the requirement to publish can be seen as "milking" the subsidy system. Others[25] point to the implications of the requirement to publish on supervision, because it is unfair to expect a postgraduate student to publish unless they have been supported to do so.

Another comment on the South African system relates to changes to governance and management occasioned by the introduction of New Public Management. Quality assurance was introduced to the system in the early 2000s[26], and the CHE has just completed its second cycle of institutional audits. In spite of attempts to manage universities in a more "business-like" manner and assure quality, dysfunction continues to haunt the system, as evidenced by the Minister placing various universities 'under administration'. For Jansen[27], corruption and other dysfunctional activities, including student protests, are related to the lack of a strong academic project and a failure on the part of all involved to understand an institution's academic project and appreciate its importance.

As this brief review of the South African system, in the context of growth in higher education systems across the globe, draws to a close, one issue remains outstanding: the student protests of 2015, 2016 and 2017. The #FeesMustFall protests resulted in important changes to the National Student Financial Aid Scheme (NSFAS). As a result of the announcement of free higher education for students with a family income below ZAR350 000 in 2017, a total of ZAR37.11 billion was disbursed to students studying at universities in 2022.[28] As the allocation to NSFAS comes from the total amount provided to the system overall, this has implications for the subsidy that universities receive to operate – a situation which has potentially grave implications for the future of the system itself.

A second issue raised by the #RhodesMustFall protests related to claims made by students that they felt alienated in the universities. These then resulted in calls for the decolonisation of the curriculum and of institutional cultures. Jansen[29] argues that "decolonisation emerged as a political keyword in the language of student protests to replace what had been the official reference post to change in the post-apartheid period: transformation" and that one of the problems that resulted was that, in contrast to other African countries, "there was no intellectual and political tradition of decolonisation on South African soil". For Jansen, this accounts for the fact that intellectual leaders in

the discussions[30,31] following the protests came from other countries on the continent. The lack of knowledge and debate in South Africa prior to 2015 also meant that South African scholars were "over reliant" on Latin American theorists[32-34] for meanings of the term 'decolonisation'. Nonetheless, the decolonisation of universities has prompted a great deal of work often completed by young black scholars (see for example Hlatshwayo and Shawa[35]).

Research on higher education in South Africa

South Africa has three journals dedicated to higher education: the *South African Journal of Higher Education* (*SAJHE*), *Critical Studies in Teaching and Learning* (*CriSTal*) and *Transformation in Higher Education*, although a number of other journals, including the *South African Journal of Science* (*SAJS*), also publish work on higher education. At an international level, journals such as *Studies in Higher Education, Higher Education, Teaching in Higher Education* (*TinHE*) and *Higher Education Research and Development* are also possible sites of publication for South African work. Tight[36] based his analysis of research globally on 15 international journals focused on higher education. Important to note at this point, is that a great deal of work produced in the field of higher education studies is focused on teaching and learning, an observation which is not surprising given the enormous changes to student bodies and to understandings of the purpose of higher education that have taken place over the last 50 or so years. Some journals, such as *CriSTaL* and *TinHE,* focus almost exclusively on this type of work. In addition, discipline-focused journals are increasingly publishing work on teaching in higher education.

In the context of this 120-year celebratory issue of the *SAJS*, I look at work published by the Journal related to higher education and draw on a broad content analysis to categorise and discuss submissions and, eventually, analyse the contribution of the Journal to the field of study. In order to do this, I draw on an analysis of all work published in the Journal since 2014 (Volume 110 onwards).

Approach

The approach to developing the exploration of published work that appears below drew on a broad content analysis. Titles of contributions to each issue were perused for a possible link to higher education. Where any doubt existed, the abstract or even the entire piece was then read. Details of each contribution were entered into an MS Excel spreadsheet and an initial category assigned to each contribution. A total of 143 articles in 52 issues were identified to relate to higher education and then read.

In order to identify categories, I drew on my own experience and expertise in the field of higher education studies. I then worked through the initial categorisation and repeatedly referred to the original publications until a final set of categories was developed. The categories identified focused on:

- the university as an institution and how it has changed in relation to shifts in the broader context;
- higher education as a system;
- higher education management;
- the academic workplace; and
- teaching and learning.

Types of contributions

SAJS publishes a number of types of contributions. Research Articles, Research Letters and Review Articles are all peer reviewed following international norms. Contributions to what is termed the 'front section' of the Journal encompass Commentaries, Book Reviews and a number of other types including News and Perspectives. Contributions to the front section are not subject to formal peer review, although they are reviewed by the Editor-in-Chief who may also assign them to other experts for additional opinions, and are not eligible for the South African Department of Higher Education's subsidy. The 143 contributions identified as related to higher education fell into a broad range of article types (see Table 1).

Table 1: Types and numbers of *SAJS* articles related to higher education, 2014–2023

Journal section	Contribution type	Number
Front section		
	Book Review	37
	Commentary	39
	Scientific Correspondence	2
	News & Views	4
	Perspective	1
	Structured Conversation	1
	Leader	17
Back section		
	Research Articles	30
	Review Articles	7
	Research Letters	5
TOTAL		**143**

Discussion

One of the most interesting observations to be made on the basis of the analysis relates to the number of Leaders related to higher education. Over the 10 years of the review period, 17 Leaders, of which only one was written by a contributor other than the Editor-in-Chief and one was co-written with another contributor, focused on higher education. In many cases, Leaders reflected on significant events impacting on the South African system more generally, such as the zero fee increase announcement made by President Jacob Zuma[37] or what really matters for students following calls for free higher education and the decolonisation of curricula and institutional cultures.[38] Significantly, Leaders take what could be seen as a controversial stance[39] by taking aim at protestors' demands, their implications for society at large and values taught in the universities more generally.

This interest in events, including the publication of policy and other documents, impacting on the higher education system and the university as an institution evidenced in Leaders, is mirrored in contributions by other authors. Tomaselli's[40] Commentary on the implications of the Copyright Amendment Bill, approved by the National Assembly in February 2024, is but one example of the critiques of events offered by authors. The Commentary, 'Who pays for someone else to consume for 'free'?', notes the impact of the Bill on universities paying the salaries of researchers who produce the work which this piece of legislation allows to be reproduced without permission or compensation.

Also notable are the 37 Book Reviews published by the Journal in the period under review with the result that, arguably, every major book published in South Africa on topics related to higher education has received attention. These include reviews on Jansen's *Corrupted*[41] and *As by Fire*[42], Jansen and Walter's *The Decolonisation of Knowledge*[43,44], Higgins' *Academic Freedom*[45], Brink's *The Responsive University and the Crisis in South Africa*[46] and *The Soul of a University*[47]. The majority of the reviews noted here are of work focused on the university as an institution, a topic which also occupies the minds of authors of other types of contributions.

The university as an institution

As an institution, the university has come under enormous pressure in recent years for the reasons outlined in the introduction to this article and, also, because of the global economic system that draws heavily on innovation and the use of knowledge to 'reinvent' existing goods and

produce and market them across the globe. Contributors to *SAJS* are clearly interested in these shifts and employ their minds to thinking about what they mean for the South African higher education system. Walwyn and Cloete's[48] analysis of expenditure on research and development in South Africa, for example, identifies a growing role for universities in the National System of Innovation , reflecting changes in the way the state has steered the creation of knowledge. This position is echoed in a Commentary written by Marivate, Aghoghovwia, Ismail, Mahomed-Asmail and Steenhuisen[49], all scholars on the Department of Higher Education and Training's (DHET's) Future Professors Programme. The piece sees universities as key to the development and adoption of technologies associated with the Fourth Industrial Revolution. The Journal has also published a number of analyses of the contributions made by universities to the South African economy. Bawa and Pouris[50], for example, provide a follow-up, 10 years later, to Pouris and Inglesi-Lotz's[51] 2014 article on this subject, challenging criticisms of the cost of a higher education system characterised by poor levels of student performance as they do so. Critiques of the construction of the role of universities as primarily serving advances in the economic system are not lacking. Overton-de Klerk and Sienaert[52], for example, provide an antidote to the thinking of constructing universities as "brands" by arguing that, although a university's reputation tends to be built globally on "research excellence", there is a case to be made for "brand relevance" allowing institutions to carve unique niches for themselves by drawing on their historical and contemporary contexts.

Unsurprisingly, calls for the transformation of higher education, heightened by the #RhodesMustFall and #FeesMustFall protests of 2015 and 2016, have elicited interest from contributors to the Journal because of their implications for the institution of the university as a whole. Archer's two-part Commentary[53,54], for example, published in 2017, argues that universities "function in specific ways in the world" and relate to society as "unique institutions" (p.1). Both parts of the Commentary then proceed to argue for the need to protect what are termed "first-order functions" from claims made by second-order functions such as equality or redress. Taking up a very different position, Adelle[55] argues for the need for "knowledge democracy" and "cognitive justice" achieved by university-based researchers working with a variety of actors "from across the knowledge–policy–practice interface" (p.2). Another Commentary provided by Long et al.[56] offers an argument for the need for the decolonisation of geography curricula not least because of "territorial demarcations on the global map, borders that at times seem to follow little more than natural boundaries chosen to divide territories between competing powers" (p.1).

Although other work on decolonisation appeared in the Journal, a Structured Conversation between Boaventura de Sousa Santos, Sabelo Ndlovu-Gatsheni and Crain Soudien[57] in a special edition on 'Radical Reason' published in 2022, is worthy of mention. This contribution sees de Sousa Santos arguing that the university has been turned into "a capitalist enterprise" because "it has become a business corporation producing a commodity whose market value derives from its capacity to create other market values (e.g. diplomas that give access to highly paid jobs)" (p.2) with Ndlovu-Gatsheni then noting "the problem of an alienated African educated elite arises – people who are alienated from their history, their cultures, their languages" (p.3). Significantly, the contribution makes the point that South African universities will not be the same after the protests as they were "pushed into a ferment, which is still going on, even if there is silence from the students themselves".

Higher education systems

A second category in the classification of contributions to the Journal was "higher education systems", with several contributions in this group focusing on the funding and efficiency of the South African system. In the context of the #FeesMustFall protests and the establishment of a commission to explore the possibility of free higher education and training, for example, Shay[58] offers four scenarios, mapped on a Cartesian plane with axes denoting "financial aid" and "educational investment". Scenario one involves high levels of financial investment on the part of the state to support students financially, and thus promote access, as well as the educational investment necessary to support the teaching and learning of diverse groups of students. This is termed an 'ideal' future. The second scenario, the 'elite' future, involves low levels of financial aid and high levels of educational investment in that students admitted to the system draw on the capital they have accrued from attendance at high quality private or good public schooling. The final two quadrants, 'waste' and 'high waste' futures, both involve low levels of investment in support for teaching and learning. In the case of the 'waste' future, funding is available for financial aid but teaching and learning conditions in the universities mean that students cannot benefit from the financial security of having fees and living costs paid. In the final quadrant, low levels of investment in education and student funding mean that fewer students can afford a higher education and their experiences of success within the universities are diminished because of the lack of support for teaching and learning. Shay's estimate in 2017 was that the South African system sat in scenario three, a 'waste' future given that, although access had widened and looked to widen further thanks to the provision of financial aid, a lack of financial support for change in teaching and learning would still result in poor outcomes in terms of throughput and graduation rates. This is arguably still true today, although a move towards a 'high waste' future could be argued given decreases in funding in the form of the University Capacity Development Grant thanks to the need for fiscal stringency in the current economic climate.

Also focused on funding, Molotja and Ralphs[59] offer an analysis of expenditure on research and development in the social sciences and humanities, showing that most funding was focused on a few knowledge areas (finance, economics, education, accounting, public policy and political science) with other fields such as architecture, psychology and transportation studies receiving strikingly low levels of support to the extent that their decline is imminent. Molotja and Ralphs go on to argue that both national policymakers and those making decisions about research funding at institutional levels need to find a greater balance if the social sciences and humanities are to be leveraged for future needs. One last contribution looking at the impact of funding on system level issues is an analysis by Moyo and McKenna[60] of the way undifferentiated implementation in a highly differentiated system has limited the impact of earmarked funding intended to enhance student performance. Importantly, this study identifies the need for support for financial management, particularly in institutions where capacity to manage has not been built over the years.

Higher education management

Given the impact of neo-liberal discourses privileging 'New Public Management' in higher education, it is not surprising that a number of contributions to the Journal fell under the category 'higher education management'. Although the Journal published work which was highly critical of New Public Management[61,62], a number of contributions examined the management of both teaching and research outputs. One significant feature of the introduction of New Public Management to universities is the appointment of individuals responsible for maximising performance in both teaching and learning and research and the tasking of academics to produce outputs which often appear as key performance indicators in appraisal systems. Several contributions to the Journal analyse ways in which performance indicators can be improved. In the teaching and learning arena, Stoop[63,64], for example, provides a model accounting for variables leading to student throughput using an approach based on the number of students in any cohort who "survive" and graduate. In a similar vein, Zewotir et al.[65] use survival analysis to identify factors leading to successful conclusion of a master's programme, while Chetty[66] and Dennis et al.[67] analyse the impact of extended curriculum programmes on performance in physics and chemistry, respectively.

Contributors were also interested in research performance, with Murray[68], for example, developing a formula to predict research output at one South African university. Diko[69] offers a more critical perspective on the quest for outputs, given the rewards that accrue from the incentivised funding formula[70], by asking whether quality, as evidenced by a journal's impact factor, ranking or number of article non-self-citations should also be taken into account when subsidy is awarded.

Obviously, doing research is about much more than striving for outputs, regardless of how this might impact on a future career or potential

financial rewards, and awareness of this is evidenced in a number of contributions. Preiser and Preiser[71] draw on experiences of publishing during the COVID-19 pandemic to note the responsibility of researchers to ensure that no harm accrues from work that is published hastily. In the pandemic, the need to combat the virus led to research being uploaded onto preprint servers which was then picked up by journalists who knew very little of scientific processes and who were disposed to ignore the tentative nature of preliminary findings. This then impacts on researchers because, as Preiser and Preiser point out, "it may be challenging to communicate nuance, uncertainty and complexity to non-scientific audiences, but not doing so causes harm" (p.2). A report on a joint ASSAf/*SAJS* webinar held in August 2021 discussing the impact and role of science and scientists in contemporary society[72] furthers the discussion on the responsibility that accrues to scientists and others involved in the production and dissemination of scientific knowledge by stressing the importance of the relationship between science and society. Another important contribution to the discussion of research and publication appears in the form of a Leader by the Journal's Editor-in-Chief and A-rated scientist, Leslie Swartz[73], who notes the challenges of editing a journal (*SAJS*) that is committed to multidisciplinarity and to "publishing high quality original research from Africa or on African relevant issues" in a context where many do not have the linkages and connections that will allow them to get the support they need to produce a paper that will withstand rigorous peer review. Even more importantly, Swartz identifies consequences that accrue from the commodification of research and research outputs, noting that "publications may be viewed as products in themselves, items to be counted and ticked off, used as materials to give access to jobs, grants, promotions and other opportunities" (p. 1), with the result that the role of writing as a means of learning in the research process itself may be lost. In this context, another A-rated scientist, Brenda Wingfield's, contributions to the Journal[74-77] provide a reassuring voice in much of the negativity about publishing and becoming a researcher by drawing on her extensive experience to identify, amongst other things, the importance of mentoring as one of the conditions necessary to develop what she terms the "culture of innovation" necessary to achieve research excellence.

The academic workplace

Unsurprisingly, given that the majority of readers of and contributors to the Journal are probably university employees, a large number of contributions fall under the category 'academic workplace'. As a rating from the National Research Foundation (NRF) is now required for appointment or promotion in many universities, it is not surprising that the system used for ratings is an object of critique. Callaghan[78], for example, is critical of a system which leaves researchers open to bias because applications are not anonymised. For this author, a more fair system would draw on "technological advances" that offer "a host of objective measures of both research productivity and its impact" (p.7). Boschoff's[79] rebuttal of Callaghan's claims then opens the way for further debate by identifying questions to be answered about the principles underpinning the NRF system. This is then taken up by Coldwell[80], arguing from the perspective of an experienced reviewer of rating applications, who notes that, while the NRF's distinctions between the 'A' and 'C' rating categories are relatively clear, the 'B' category, which requires reviewers to indicate that researchers enjoy "international acclaim", is difficult to operationalise. McRobert and Stergianos[81] add to the discussion by noting that, for engineers, using a journal paper to gauge impact is simplistic, as recognition by industry in the form of prizes, fellowships and invited lectures provides a more reliable measure of research standing. Regardless of the merits and demerits of each contribution, the debate in the pages of the Journal is indicative of an acute interest on the part of readers and contributors in an aspect of the academic workplace with the potential to impact on their careers and of their willingness to bring their intellectual acumen to its interrogation.

The theme of the 'academic workplace' also encompasses a number of contributions about gender inequalities. The precarity of women's careers during the COVID-19 pandemic is addressed in a contribution by Walters et al.[82] who note the impact of the pandemic on women in particular. Their survey showed that many women were employed on temporary, soft-funded contracts which were threatened by lockdowns and, also, that the additional demands placed on women during lockdowns impacted on their prospects for promotion, especially as, in many cases, sabbaticals intended to be devoted to writing for publication were lost. However, gender imbalances in science were also taken up by Butler-Adam in a Leader[83] responding to Minister Naledi Pandor's statement[84] that "[t]he challenge for Africa is to ensure that the gender imbalance in the practising of science, technology and innovation [STI] is addressed", with the pronouncement that there can be "no more excuses" for the lack of advancement of women.

Teaching and learning

A final category in the analysis of contributions to *SAJS* was 'teaching and learning'. Submissions in this area encompass Nyika's[85] discussion of the use of the mother tongue as a language of learning and teaching, Mguni et al.'s[86] analysis of the visualisation skills required by biochemistry students as well as work focusing on postgraduate education. Grossman and Crowther[87], for example, address the topic of co-supervision and the need for a coordinated approach from both supervisors. By and large, however, contributions on teaching and learning are not a major focus in the Journal, an observation which is, perhaps, not surprising given the number of journals that specialise in publishing work of this nature.

Conclusion

As a knowledge field, higher education studies would be classified as a region[8], in that it faces inwards towards the disciplines and outwards towards a field of practice. Looking inwards, higher education studies draw on a range of disciplines including sociology, history, politics, linguistics, and economics. Increasingly, the field is the domain of specialists who are often located in departments or centres and whose intellectual attention is focused on researching and teaching about it. However, the status of higher education studies as a region makes it accessible to many non-specialists who can bring their own disciplinary expertise and experience of teaching and working in universities to bear in its enquiry and analysis.

The existence of journals that specialise in publishing work on higher education has already been noted. As a multidisciplinary publication with a wide readership whose interests are located in a range of knowledge fields, *SAJS* clearly does not fit into this category in spite of the numerous contributions related to higher education that it has published over the past 10 years. However, contributions by experts in knowledge fields privileging quantitative analysis[68-72] who, for example, attempt to identify factors leading to, amongst other things, enhanced student throughput, and others[45,47,49,50,61,66,67] from authors with backgrounds in the social sciences who bring their criticality to bear on the conditions in which they work in contemporary universities are evidence that the Journal offers a space for readers whose publications might otherwise reflect their disciplinary backgrounds more strongly but whose interest in higher education leads them to research, think and write about it.

There is, of course, another reason why contributions to higher education studies published in *SAJS* are important. Often work on higher education appears in the specialist journals noted earlier in this piece, which do not reach the more general academic readership of *SAJS*. The contributions to *SAJS* thus have the capacity to keep a wide range of disciplinary experts abreast of developments in higher education globally and nationally and, importantly, to be informed as they sit on bodies such as faculty boards and senates where developments that may impact on their lives may be discussed and where some criticality may need to be introduced.

Declarations

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A perspective on South African engineering

Significance:

As part of the 120th anniversary celebrations of the *South African Journal of Science,* this paper highlights some of the engineering contributions to the Journal, and celebrates some of the achievements of one of South Africa's most outstanding engineers – Hendrik Johannes van der Bijl. By briefly retracing his developmental history and motivation, we can better understand his path to prominence, and his contributions to the industrialisation of South Africa. This Perspective also reflects on what his work and career might teach future generations of South African engineers and engineering educators.

The first issue of the *South African Journal of Science* (*SAJS*) was published in Albert Einstein's *annus mirabilis* – 1905. In that year, Einstein published five papers of groundbreaking importance that in many ways marked the beginning of modern physics.[1] In his first paper, Einstein combined the techniques of classical hydrodynamics with those of diffusion theory to create a new method for determining the size of molecules. His second paper was a study of Brownian motion and constitutes one of the high points in the long tradition of research on the kinetic theory of heat. This work contributed to the acknowledgement of the physical reality of 'atoms' by the then still numerous sceptics. His third paper introduced the special theory of relativity that links time and distance. This paper showed that the concept of absolute time, on which Newtonian kinematics is based, had to be abandoned (or at least modified). The fourth paper, which is a consequence of the special theory of relativity, develops the principle of mass-energy equivalence as embodied in his famous equation, $E = mc^2$. The fifth paper is an examination of the photoelectric effect, which analyses the energy of light quanta; work for which he received the 1921 Nobel Prize for Physics. In the same year (1905), the *SAJS* published a wide range of papers on education, mathematics, astronomy, chemistry, mining and geology, lightning, electric power distribution, wireless telegraphy, and vehicular transport.

In more recent times, the *SAJS* has provided coverage of several topics of current engineering significance. In response to its rapidly increasing importance, South African researchers and institutions have increased their efforts in nanotechnology.[2] 'Big data' and artificial intelligence (AI) in health science research in sub-Saharan Africa are examined in a special issue.[3] The articles in this special issue explore the benefits of data science; the importance of data management; and the ethical and legal issues raised by the gathering and use of mobile phone data. The Fourth Industrial Revolution speaks to a confluence of technologies and the synergy of computing, data, and communications technology, with AI.[4] The results of an effort to identify the performance of energy and fuels research in South Africa during the period 2003–2013 is reported in Rudman et al.[5] Emergency medical services (EMS) are a vital component of the health system, and provide pre-hospital emergency care, and specialised transport for patients requiring access to healthcare facilities. Evidence regarding the current state of EMS within South Africa to fulfil this role is lacking and motivated a recent review.[6] A review of CO_2 emissions in the South African power generation sector is given in Osman et al.[7], with potential process engineering solutions to reduce them suggested.

I will now develop the hypothesis that the industrialisation of South Africa began on 23 November 1887, when Hendrik Johannes van der Bijl (Figure 1) was born in Pretoria. At the time, the Witwatersrand Goldfields had recently been discovered – an event that contributed to the outbreak of the Anglo-Boer War. In 1902, his parents moved to the Cape, where van der Bijl was able to complete his schooling away from the rancour of war. After matriculating at Franschhoek High School (in 1904), he spent three years at Victoria College (now Stellenbosch University). He received a BA degree, winning prizes for mathematics and physics.[8]

In 1908, Van der Bijl was unable to resist a call to move to Germany and study physics. At the time, outstanding questions included the determination of the structure of the atom, the verification of Einstein's theory on the photoelectric effect, and the determination of the mass and charge of the electron (the charge-mass ratio had already been determined by J.J. Thompson in 1897). In 1912, he completed his PhD thesis on the behaviour of ions in liquid dielectrics.[9]

After obtaining his PhD, Van der Bijl was appointed assistant in physics at the Royal School of Technology in Dresden under the supervision of Wilhelm Hallwachs, who, in 1888, hypothesised that a conductive plate would emit electrons when subjected to ultraviolet light. In 1900, Max Planck proposed a quantum theory that explained the absorption and emission of electromagnetic waves (light quanta). In 1905, Einstein applied quantum theory to the photoelectric effect and proposed the relationship $K_{max} = h(\nu - \nu_0)$, with each quantum of light carrying energy $h\nu$, where ν is the light's frequency and h is Planck's constant. Because the kinetic energy K_{max} must be positive, $\nu > \nu_0$ is required for photoelectric emissions to occur. The frequency ν_0 is the threshold emission frequency associated with the material being considered. To satisfy Einstein's equation, the maximum electron stopping voltage had to be in the region of a few *volts*, but several workers found figures more than ten times greater. Van der Bijl suspected that the field, due to the relatively high anode voltage, penetrated the grid as a corrupting 'stray field'. This quandary led to a fortuitous meeting with R.A. Millikan, who arranged for the American Telephone and Telegraph Company to offer him an appointment in their then embryonic research organisation, which in 1925 became the famous Bell Telephone Laboratories. Arguably, Van der Bijl's move to America in 1913 marks his metamorphosis from physicist to electrical engineer.

Image: The Royal Society[9]

Figure 1: Hendrik Johannes van der Bijl.

Image: H. W. McCandless and Co. Reproduced under a GNU Free Documentation Licence.

Figure 2: An audion invented in 1906 by the American engineer Lee De Forest. The top metal electrode is the plate. The zigzag metal wire (partly visible) is the grid. The filament is located at the bottom.

The American Telephone and Telegraph Company had recently acquired the patent rights to Lee de Forest's 'audion', which is a three-electrode amplifying device (Figure 2). The reason for acquiring these rights was its possible use in long-distance telephony. However, before the audion could be used for this purpose, research had to be done to study its performance characteristics, and to arrive at a vacuum tube design that was suitable for commercial production. Van der Bijl's background was ideally suited to this task. Although it was used for a very different purpose, the audion was essentially a replica of the photoelectric tubes he used in Germany in his work on the photoelectric effect; the illuminated zinc plate was replaced with a hot filament as the electron emitter.

In 1914, a three-electrode valve amplifier was used in a commercial telephone system that connected New York and San Francisco. Inventions related to amplifying devices (Figure 3), feedback, and circuit theory provided a sound basis for the design of feedback systems that arise in many fields of engineering including chemical processing, electric power generation, and ship and aircraft autopilots. These applications led to a then new engineering discipline known as 'control theory'. Most importantly, Van der Bijl's stay in the USA exposed him to the methods of modern industry.

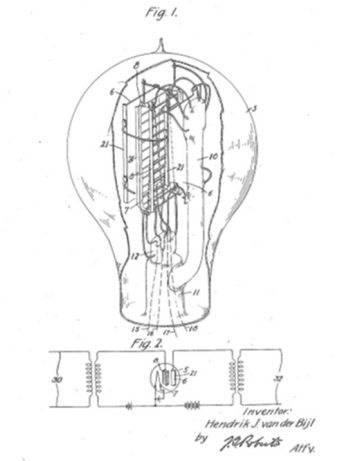


Image: Taken from Hendrik J. van der Bijl's 1923 patent US 1,478,072

Figure 3: A vacuum tube having a double plate anode 6, a cathode 7 and a double grid 8.

His work on the design and theory of the vacuum tube, and the mathematical characterisation of its operation, led to a treatise on the thermionic valve which he published in 1920.[10] This was the first book on the subject and remained a standard work for many years to come. The development of the audion was accompanied by other groundbreaking developments that all contributed to the long-distance telephone system. These included the development of the feedback amplifier by Harold Black[11] and the work of Hendrik Bode[12] and Harry Nyquist[13] on feedback system design and stability. There was also the network synthesis work of the famous South African researcher Otto Walter Brune.[14]

By 1936, it was decided that the vacuum tube was not going to be the ultimate answer to electronic amplification. Their reliability, size and power consumption were such that simply making them smaller, and more efficient, was not going to suffice. In 1925, J.E. Lilienfeld filed a patent for the field-effect transistor. The field-effect transistor is another three-terminal amplifying device, similar in some ways to the vacuum tube developed by Van der Bijl and his colleagues. This Bell Telephone Laboratory work culminated in what we now know as the 'transistor', for which John Bardeen, Walter Brattain and William Shockley received the 1956 Nobel Prize for Physics.[15]

In 1919, Field Marshal Jan Smuts became Prime Minister of the then Union of South Africa and decided that his cabinet needed a Scientific Advisor. Having heard of Van der Bijl's achievements in America, he decided Van der Bijl was 'the man for the job'. In 1920, Van der Bijl returned to South Africa to take up this new post. Not long after returning to South Africa, Smuts persuaded Van der Bijl to form a national electricity supply company; Van der Bijl was made Chair of the newly established Electricity Supply Commission (Escom). Van der Bijl saw that the two pillars on which South African industry could be built were electric power and steel. In 1925, the Iron and Steel Corporation (Iscor) was formed.

At the onset of World War II, Van der Bijl was made Director General of War Supplies and, in a short period of time, was able to mobilise the country's limited industrial resources. As a senior civil servant, Van der Bijl was expected to join the cabinet, but he declined to do so, explaining that[8]:

> *At present I have no enemies that I know of, but if I join the Cabinet I shall immediately have 40% of the population against me and I shall have to waste my time making conciliatory and tactful speeches.* (p.9)

In the years to come, Escom maintained its ambition, and in 1976 the construction of the Koeberg Nuclear Power Station began. As with any new venture of this type, teething problems occurred. One such problem was the possible onset of subsynchronous resonance, which is a potentially damaging electro-mechanical instability caused by the compensation capacitors required in long transmission lines (>1000 km

in this case). At the time, Escom conducted its own research[16] and also funded and conducted research with South African universities[17]. Escom was then a healthy enterprise that was presented with the Power Company of the Year Award at the Global Energy Awards ceremony held in New York in 2001.

In more recent times, Eskom's fortunes have declined (Escom became Eskom in 1987). Figure 4 shows the degradation of the energy availability factor of the Eskom fleet over a recent 7-year period; the cyclic variations were a result of seasonal maintenance schedules. This downward trend in availability was due to a combination of deferred maintenance and equipment ageing, which does not bode well for the future of the country's heavy industries, businesses and private consumers.

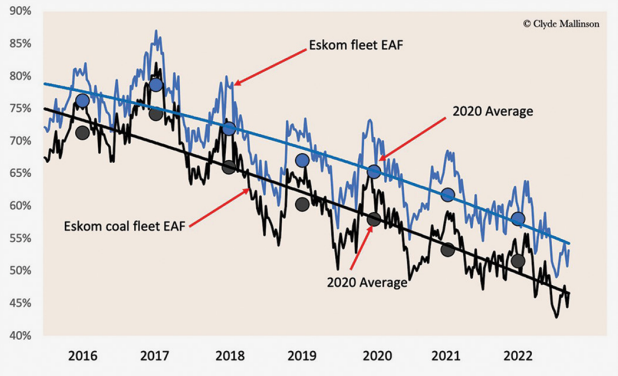
This problem was masked to some extent by the introduction of renewable energy supplies, with some recent estimates given in Table 1.

While renewables and residential rooftop photovoltaic (PV) installations represent a helpful contribution to the country's energy mix, one must be careful in interpreting these figures. In the case of solar, assuming that the sun is available only half the time results in an energy availability factor (without battery storage) of approximately 50%. In the case of wind, the energy availability factor could be as low as 20%. Another issue is that the increase in installed rooftop PV represents a significant investment that must be borne by the broader economy — somewhat akin to replacing the Department of Water and Sanitation with JoJo tanks. In other words, private citizens, many of whom have limited resources, are being required to subsidise the country's central infrastructure.

In 2019, BizNews published an open letter from an Eskom engineer of 30 years' standing[20], which is another cause for concern. Alex Ham held the position of Chief Engineer: Power Station Design. During this period, he was responsible for the overall design of Eskom's Lethabo, Majuba, Matimba and Kendal Power Stations. His expertise was in the design of pulverised coal boilers. Prior design experience at Kriel Power Station motivated his in-depth study of the combustion properties of South African coal.[21] This work showed that boiler designers have to make allowances for slow-burning South African coal that must be ground much finer than is required elsewhere. In the case of the boilers for Lethabo, Majuba, Matimba and Kendal Power Stations, increased furnace dimensions were specified, together with tube mills in place of previously used vertical-spindle rotating table mills. Tube mills produce finer ground coal, as was proven at Lethabo Power Station. The prior experience of the boiler contractor for Medupi and Kusile was with Australian and Japanese coal. On the basis of the limited information available to him, Ham concluded that the Medupi and Kusile boilers were undersized for slow-burning South African coals, and that the flue gas velocities were too high, causing excessive erosion of the burners and furnace tubing. This episode raises two important questions: (1) Does Eskom still have the expertise to monitor and advise outside contractors in order to avoid mistakes of this kind? And (2) why did Eskom and its contractors not apparently take advantage of the knowledge and experience of its own engineers?

Another troubling coal-related incident that occurred at Eskom relates to Dr Mark van der Riet who was Eskom's coal combustion expert. His case is dealt with in the Zondo Commission report[22] (see paragraphs 2017 to 2045), while a summary account can be found in Hogg[23]. In August 2015, Dr van der Riet was informed by his Quality Assurance staff that the quality of the coal from Brakfontein colliery had deteriorated – an independent laboratory had recently failed 50% of the samples provided. The samples were retested by a SABS laboratory and 97% of the coal was deemed too poor for Eskom's utility. Following a period of fractious disagreement over testing protocols and alleged transgressions of Eskom's Coal Quality Management Procedure, Dr van der Riet and his team were served with a notice of intended suspension.

When contemplating the way forward, there are a number of fundamentals that are worth reviewing. Engineers are like oak trees – there are too few of them and it takes many years to grow new ones. No matter how loud the howls of protest might be, physical law is indifferent to the whims of politics. It would be folly to try and pass legislation



Source: Daily Investor.[18] Figure reproduced with the permission of Clyde Mallison.

Figure 4: The Eskom fleet energy and coal fleet energy availability factors (EAF).

Table 1: Estimated renewables and rooftop power sources

Currently installed capacity (megawatts)	
Concentrating solar power	500
Photo voltaic	2287
Wind (Eskom & independent power producers)	3443
Hybrid	150
Total (including other renewable energy sources)	6430
Estimated rooftop photovoltaic	5440

Source: Yelland[19]; reproduced with permission

that changes, for example, the laws of thermodynamics. Engineers are trained to understand these laws, work with them, and avoid their many and varied snares. The most talented engineers are also the most mobile – if, for whatever reason, they dislike their working environment, they can relocate to other employment. South Africa's pool of engineers must be expanded and properly balanced between the private and public sectors. As was the case with Hendrik van der Bijl, and many others like him[14], our promising young engineers should be routinely encouraged to gain experience in world-class engineering environments.

There is an obvious and urgent need for more engineers to rehabilitate South Africa's failing infrastructure. To that end, non-extractive external investment must be encouraged, and barriers that impede the attraction and recruitment of the very best engineers to the public sector should be removed.

Engineering educators must be mindful of at least three responsibilities. Firstly, there is a responsibility to the reputation of their home institution. Secondly, they have a responsibility towards the country and future employers to ensure that their graduates are adequately trained. Thirdly, and most importantly, there is a responsibility towards their students. I am routinely asked by students about the development of their careers, with possible employment in South Africa's state-owned enterprises a standard topic. My hope is that soon it will become easier to encourage students to move into our state-owned enterprises, where they will have an opportunity to contribute to South Africa's infrastructure, taking inspiration from the legacy of one of our country's greatest engineers, Hendrik van der Bijl.

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Declarations

I have no competing interests to declare. I have no AI or LLM use to declare.

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Reflections on the humanities and social sciences in the *South African Journal of Science*

Significance:

The 120th anniversary of the *South African Journal of Science* (*SAJS*) presents an opportunity to reflect on the role of the humanities and social sciences (HSS) in South Africa, particularly through the lens of the *SAJS*. The HSS offer critical, complex, multi-vocal thinking and analysis, the questioning of established norms and normative ideas, and can (and must) make important contributions to the equal and just future that we imagine and continue to work towards. The *SAJS* has become a publication of choice for scholars addressing these important questions in the HSS.

In 2023, the National Institute for the Humanities and Social Sciences celebrated its 10-year anniversary. The Institute was established in response to a perceived 'crisis' and aims to support and advance "scholarship, research and ethical practice"[1] in the humanities and social sciences (HSS). This year, as South Africa celebrates its 30th year of democracy, and the *South African Journal of Science* (*SAJS*) celebrates its 120th year, it is apt to focus on the state of the HSS and their role in society. In this Perspective, we consider a brief history of the HSS in post-apartheid South Africa as well as the role the HSS have played specifically in the *SAJS*. We reflect on the first author's position as Associate Editor in the HSS portfolio, considering the range of submissions received and the ways in which they address national and global priorities more broadly, commenting too on the place of HSS in the *SAJS*.

As South Africa emerged into a new democracy in 1994, discourses around the HSS emphasised the notion of 'crisis'. The crisis discourse was bolstered by declining student enrolments in humanities degrees, relatively lower graduation rates and decreased funding, with a 13% decrease between 1996 and 2008.[2]

Post-apartheid government policies favoured the STEM disciplines, which contributed to the reduced support for the HSS.[2] Pillay and Yu[3], who conducted an analysis of student enrolment data between 1999 and 2007, argued that the declining enrolments had to be understood as relative, in relation to the growth in other disciplines that offered graduates immediate pathways to employment and income generation. They also suggested a contextualisation of the 'crisis' in a post-apartheid context of increasing economic and consumerist pressures.

Nationally, a number of interventions were undertaken to address the state of crisis in HSS. The report on the Charter for the Humanities and Social Sciences was commissioned by the South African Department of Higher Education and Training.[4] The report presents a rationale for the strengthening of the HSS in South Africa, for the continent of Africa and the Global South more broadly. Apart from "creating responsible, ethical citizens" (p.24), it is argued that we need to rise to meet the long-term needs of South Africa, given the pivotal role it plays in Africa and the Global South. In this way, the recommendations in the report go well beyond addressing the question of the crisis.

Some of the challenges and trends the HSS are meant to address include: the need to create liveable cities and to meet the food challenges associated with their creation; questions around planetary health and an associated focus on green energy production and consumption; the proliferation of epidemics and hazards; the rapid increase of digital technologies with widespread implications for all aspects of human communication; and the deepening, unrelenting realities of social inequity – specifically gender inequality.[4] The particular challenges for South Africa are articulated as follows:

> *…it has one of the most dangerous patterns of life chance and income inequality in the world; a pattern threaded through with race and gender overtones; it has demonstrated some of the most extreme forms of violence against and abuse of women and children in the most intimate spaces of sociality; it has one of the weakest basic education systems on the African continent with high rates of youth unemployment, with volatile gang and gang-related cultural formations and finally its elites, predominantly white and increasingly black, are prone to predation and demonstrate an alarming lack of social responsibility.* (p.25)

The HSS must play a crucial role in the global and local challenges we face, from offering a depth of understanding of society, culture, language, history and interpersonal relationships to the promotion of peace and harmony, but also fostering sorely needed values of social justice and equality. In these times when popular conservative rhetoric and other ideologies of hate, discrimination and exclusion gain massive traction – and where we are faced with the real-time horrors of genocide, war and the killing of innocent civilians including children, now especially those in the midst of it in Gaza – we know and deeply understand the importance of critical thinking to make sense of the world around us and towards the pursuit of equity and justice for all. The HSS offers a "critical engagement with the past and an understanding of what forms of excellence, dignity and relevance are appropriate for a dynamic and globalizing world"[4(p.26)].

The world we live in is complex, unpredictable and ever-changing. It is a world that needs the critical thinking, empathy, and understanding that the diversity of disciplines and fields in the HSS can bring. The HSS are not only about studying society and culture, they are about understanding the human condition in all its varied forms. The HSS

offer a needed set of analytical skills, informed analysis, judgement and creative critique, along with essential bodies of knowledge about society and the wider world.[2] Research in the HSS offers critical, complex, multi-vocal thinking and analysis, the questioning of established norms and normative ideas, and can (and must) make important contributions to the equal and just future that we imagine and continue to work towards.

This article reflects on the submissions undertaken in the first author's role as *SAJS* Associate Editor for the HSS between 2022 and 2024, with the purpose of reviewing the submissions received in this portfolio during that time, for an indication of the thematic areas they constitute and the ways in which they address the priorities for the HSS more broadly.

SAJS Social Sciences and Humanities portfolio: 2022–2024

In 2022, *SAJS* published a special issue entitled 'Waste as a Resource', which raised questions about existing waste management strategies and legislation and the socio-economic realities of South Africa. It aimed to offer local solutions to existing economic and social problems, making a case for a circular economy that positively shapes social and economic resilience and is important too for planetary health. The issue offered insight into the current societal and environmental issues in waste management, technology and practices, while at the same time foregrounding the socio-economic challenges within which these aspects require contextualisation. Overall, the argument for a deliberate move to a circular economy is recognised as important in an African context to stimulate job creation and income generation – whilst also addressing questions around environmental degradation and impacts. It is argued that cross-sector, government, civil society, business and academic communities must "collaborate on initiatives that build on circularity principles to advance sustainable development in pursuit of equitable and just societies"[5].

Another important special issue published in 2022 – 'Radical Reason' – emerged from deliberations at the 2020 Science Forum South Africa (SFSA) and aimed to foreground how:

> *…the issues which trouble the world – chiefly those of social inequality and planetary sustainability – can be approached through insightful inquiry, and how solutions may be proposed which offer pathways to new futures which are just, equitable and sustainable.*[6(p.1)]

The 2020 meeting of the SFSA foregrounded the HSS – and its role in tackling the challenges faced in South Africa; and additionally as a response to the recognition that the COVID-19 pandemic was not simply

> *a biomedical question, but had deep implications for how people lived as both individuals and communities, how they managed their livelihoods and how they could begin the process of cultivating social imaginations of compassion, care and solidarity in the face of worldwide retreats into self-serving nationalisms, and ethnically and racially defined self-preservational forms of isolationism.*[6(p.2)]

The COVID-19 pandemic and its associated exacerbation of conditions of inequality demanded that the HSS be foregrounded. Within this context, the special issue on Radical Reason offered a deliberate attempt to enlarge questions of reason, radical reason, with the recognition of the deliberate historical foregrounding of Eurocentric logics at the expense of African and Global South perspectives which have much to offer, not only for their own contexts but also for the world. It is argued that

> *radical thought, science, ethics, institutional arrangements, and other shared systems of valuation and understanding, are required to give depth and meaning to the full articulation of the questions that need to be asked now to engender the arrival of a just and equal world to come.*[6(p.2)]

The voluminous growth in digital technology, AI and the associated debates being foregrounded in the field propelled the publication of the 2023 special issue on 'Big Data and AI in Health Sciences Research in Sub-Saharan Africa'. This special issue introduces a broad range of scientific, ethical, legal and social issues surrounding data-intensive research and AI as it concerns African researchers.[7] The issue raises questions around the ethics, sharing and protection of data from the perspective of African researchers undertaking data-intensive research. In the contexts in which mobility and location data are increasingly being collected, used for health and other research, and largely without awareness and consent, there have been increasing questions and concerns about the collection, use and sharing of these data.[8,9] Silences around the widespread use and sharing of these data have been foregrounded to ask questions about legal, ethical and other protections that might be necessary – grappling with questions of personal data protection, the protection of privacy, consent, liability and accountability.

Aside from the thematic areas explored in the special issues over this period, there were several other themes that emerged from papers published in *SAJS*. These themes include a focus on COVID-19 explored through questions around the impact it has had on the mental health of university students in South Africa (a group already recognised as vulnerable to experiencing a range of common mental health challenges such as depression, anxiety and suicidal ideation)[10]; as well as through a paper that explored the role of the collection of electronic consent in a COVID-19 vaccine implementation trial in South Africa with a focus on participant perspectives on the understanding and preference for electronic consent – noted as important for reassurance that consent is provided with full recognition of the risks and benefits of participating in research[11]. Following the theme around questions of vaccine consent and uptake within the context of the COVID-19 pandemic and its path of destruction in South Africa, Moodley[12] raised the question around the ethics of vaccine mandates, arguing for its implementation in the context of an over-burdened and stressed health system, the South African context of high HIV prevalence, chronic illnesses and other contextual challenges.

A further theme that characterised submissions during this period was a focus on road safety in South Africa – timely, given that South Africa has one of the highest rates of road traffic deaths.[13] Given the massive role that alcohol plays in the burden of road traffic injuries and crashes, and the political and public conversation around zero tolerance drink-driving legislation, Sukhai et al.[14] explored global research and experience on the adoption of zero-tolerance approaches – considering these within the South African context and landscape. Their paper makes important evidence-based, contextualised recommendations for the advancement of zero-tolerance legislation in South Africa. Further to the question of road safety, Bantjes et al.[15] explored questions of pedestrian safety and motorists' attitudes to the law and driving practices in South Africa. A key finding in this work was that male gender was associated with unsafe driving, which was also associated with personality factors such as aggression, impulsivity, risk tolerance and altruism. A disregard for the law was also described as a key determinant of unsafe driving.

SAJS toward addressing questions that trouble the world: An abbreviated history

The post-apartheid moment also offered an opportunity for the *SAJS* to recognise the importance of the HSS where, between 1994 and 2002, a decision was taken to include papers submitted in these areas.[16] Following this, concerted efforts were made to invite and include a greater number of contributions from the HSS disciplines.

In its 2006 report on research publishing in South Africa, the Academy of Science of South Africa (ASSAf) recommended that the SAJS widen its scope to better enable the publication of multi-, trans- and interdisciplinary research, which includes broadening to enable a suitable publication for scholars in the HSS.[17] The Journal implemented several changes to address the recommendations emerging from the report which included the appointment of an Associate Editor in the Humanities and Social Sciences – enabling a widening of the scope of SAJS from its historical focus on the natural sciences.[18]

As reflected in the above brief snapshot of submissions, the *SAJS* has now become a publication of choice for scholars addressing important questions in the HSS and this portfolio in the Journal has grown considerably since ASSAf first made its recommendations – submissions recently surpassing those in the physical sciences.[17] Questions about planetary health and sustainability; physical and mental ill-health propelled by pandemics and its associations with societal patterns of inequity; questions around pandemics and mandatory vaccinations; the ethical, legal and other implications of growing digital technologies in the contexts of 'big data' and the sharing of health-related data; as well as road safety and its associations with normative gendered patterns are just a fraction of the thematic areas published in the *SAJS*. These questions speak to many of the issues that 'trouble us' as South Africans, but they are also globally relevant.

Looking to the future and greater alignment in the *SAJS* with scholarship that "offer(s) pathways to new futures which are just, equitable and sustainable"[6(p.1)], we would encourage contributions that speak to the specific challenges articulated above in the Charter for the Humanities and Social Sciences. These include a focus on the mechanisms and patterns that underlie violence and inequity and how these are threaded through gender, race and other intersections of oppression and difference; a focus specifically on gender-based violence and femicide which continue to be relevant locally and globally; inequalities that are pervasive in our education system; the implications of youth unemployment, gang violence and predatory forms of hyper-capitalist extraction and consumption. In sum, we welcome dialogue, innovative, multidisciplinary scholarship and reflective engagement on the progress we have made toward the just, sustainable and equitable future that we all imagine.

Declarations

F.B. is the *SAJS* Associate Editor for the Social Science and Humanities and P.M. is the *SAJS* Intern. There are no competing interests to declare. There is no AI or LLM use to declare.

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Navigating the 'Anthropocene': Trends and opportunities in modern organismal biology

Significance:

In this Perspective, we reflect on the rich history of organismal biology in South Africa, particularly focusing on the manuscripts submitted to the *South African Journal of Science* (*SAJS*). Some of our discussions highlight the evolution of organismal research in South Africa and its significance within the South African scientific community. A key contribution of this piece is its exploration of submission trends in *SAJS* and the identification of pressing research needs for the Journal. We also emphasise areas that warrant further investigation that could enhance the field of organismal biology.

An overview of organismal biology in South Africa

South Africa boasts extraordinary levels of biodiversity and endemism relative to many other countries worldwide.[1,2] This diversity results from the country's unique habitats and a wide range of climatic zones and biomes, such as the beautiful Nama Karoo of the Northern Cape, the Savanna of the Limpopo, the humid coastal Mediterranean climates that boast of fynbos, and many others. Many European settlers and explorers in the 17th and 18th centuries recorded the region's diverse flora and fauna, laying the foundation for future scientific studies. These early records, primarily by nature enthusiasts, formed a baseline of how the region looked before the Anthropocene period. Most research was centred around natural history, behaviour, and species composition during this period.

With the rise of modernisation and industrial development, scientific research in South Africa saw notable advancements in organismal biology. The establishment of scientific journals like the *South African Journal of Science* (*SAJS*) in the early 1900s is a testament to the growth of scientific research in general. The late 19th and early 20th centuries saw the establishment of vital scientific institutions that advanced organismal biology. Similarly, when one thinks about the establishment of museums and various botanical gardens, such as the Kirstenbosch National Botanical Garden, one can see how these institutions provided crucial infrastructure for biological research. The University of Cape Town and other universities began offering programmes in biological sciences, fostering local expertise. The early 20th century saw the burgeoning of iconic wildlife protection areas such as Kruger National Park, Addo National Park, and many others, to protect against overexploitation of the dwindling wildlife.

Most documented organismal biology research during the early colonial period was conducted by researchers, enthusiasts, and explorers of British descent. However, South African universities, such as the Mammal Research Institute/Zoology at the University of Pretoria, the Botany Department at the University of Cape Town, and departments at the University of KwaZulu-Natal, were already conducting world-class research in Zoology and Botany well before 1994, despite being non-transformed.

After 1994, when South Africa became a democracy, scientific research in South Africa underwent significant transformation, with a new focus on addressing past inequities. This shift led to accelerated growth in both the quality and quantity of research, bolstered by increased international collaboration and improved funding. While researchers in South Africa had already begun engaging in global scientific discourse prior to 1994, this engagement expanded further post-apartheid, and many more of the country's top experts in ecology, conservation, and biodiversity are now recognised as leaders in their fields worldwide.

Despite this meteoric rise in biological research over the past century, the impacts of human activities have equally accelerated, primarily due to population growth and urbanisation. Consequently, there has been a shift in ecological research from exploratory and natural history studies to understanding the effects of climate change, habitat destruction, and invasive species on local biodiversity and ecosystem functioning. Furthermore, the country's unique position as a biodiversity hotspot, particularly in regions like the Cape Floristic Region, has driven research on conservation and sustainable management of natural resources.

The history of organismal biology in South Africa reflects the country's broader social and political changes. From its early beginnings to its current focus on addressing the challenges of the Anthropocene, the discipline has become a vital component of South Africa's scientific landscape. With its rich biodiversity and dynamic research community, South Africa continues to contribute significantly to our understanding of the origins of life on Earth.

An overview of submissions in Organismal Biology

As one of the authors (S.M.) is the *SAJS* Associate Editor for Organismal Biology, we have chosen to focus on submissions to *SAJS* during his tenure (2019–2024). These submissions have been on various topics and in various sub-disciplines of organismal biology (see Table 1). Below we give an overview of some of these submissions, highlighting those papers that were not handled jointly with other *SAJS* Associate Editors.

In this time, papers in the Organismal Biology portfolio have spanned the fields of ecology, conservation, environmental sciences, evolution, behaviour, genetics, and biodiversity. A paper in genetics utilised DNA-based methods to study zooplankton diversity in South African ecosystems.[3] Similarly, some papers have shown how metabarcoding can give insights into South Africa's rich insect biodiversity.[4] In ecology, research articles include one on an investigation into the impact of environmental factors on species distribution and population dynamics. Other studies have explored the genetic basis of adaptation and speciation in different organisms – for instance,

Table 1: Papers submitted to *SAJS* within the Organismal Biology, 2019–2024

Discipline	2019	2020	2021	2022	2023	2024
General ecology‡	6	2	5	2	3	1
Behavioural ecology	0	0	0	0	0	0
Conservation & environmental sciences	2	0	2	1	1	0
Genetics & evolutionary biology	0	0	0	1	0	1
Manuscripts submitted	**11**	**11**	**9**	**2**	**5**	**7**
Articles published	**8**	**2**	**7**	**4**	**4**	**2**

‡Includes organismal, population, community, and landscape ecology

Mungenga et al.[5] collected data on insecticide resistance in various mosquito species. In the environmental sciences, research papers included the impacts of pollution, water quality, climate change, and land use changes on diverse South African ecosystems. For instance, some researchers[6] explored the potential of using biochar to lessen the harmful effects of sewage effluent.

Some researchers[7] studied land use changes in rural landscapes of South Africa and showed how vegetation cover changes could affect societies and biodiversity in South Africa. Other key contributions include a paper in which researchers used a novel method to provide spatially explicit information on ecosystem assets and their services to support natural resource management.[8] Findings from studies that assess ecosystem services are useful because they inform ecosystem management and restoration efforts in South Africa and Africa. To a lesser extent, papers in anatomy and physiology have included those on the physical structure and form of organisms, including comparative anatomy across species or within a specific group. In a research paper published in 2022, Rossouw[9] comparatively studied anatomical differences in two subspecies of springbok. Several manuscripts on behavioural ecology (see Table 1) included analysis of the behaviour of organisms in their natural environments, such as the mating behaviour, social structure, and foraging strategies of organisms. While these manuscripts were subsequently rejected after review, this field could contribute significantly to *SAJS*.

In the environmental sciences, very few studies have been submitted that assess strategies for sustainable resource management. Further, the Organismal Biology portfolio has not received reviews discussing emerging ecological monitoring and remediation technologies. It is also worth noting that very few interdisciplinary research studies have been submitted during the period 2019–2024. First, there is a dearth of collaborative projects bridging multiple disciplines, such as bioinformatics, biophysics, and computational biology. Second, articles exploring the interface between biology and other fields, including engineering, computer science, and social sciences, would be very welcome. Third, studies that integrate empirical data with modelling approaches to address complex organismal questions are also warranted in the Journal. Fourth, reviews synthesising knowledge from diverse disciplines to tackle global challenges like infectious diseases, climate change, and food security are also scanty. Last, within conservation biology, *SAJS* received a few submissions addressing conservation issues related to organisms, biodiversity and conservation strategies, threats to species, and conservation management practices. Conservation biology may be needed in organismal biology in *SAJS* (see comments below).

Though over a decade old, the seminal work of Schwenk et al.[10] still rings true, as they identified five grand challenges facing the field of organismal biology. While I do not have time to delve into all the details of everything contained in Schwenk and collaborators' paper, the paper does highlight five key needs in organismal biology: (1) the need to unravel the role of organisms in their environment, (2) the need to study the functional diversity of organisms, (3) the need to integrate living and physical systems in analyses of biological systems, (4) the need to understand how genomic changes create various phenotypes, and (5) understanding how organisms shift between stability and change in various ecosystems. *SAJS*, in terms of all the submissions received, still needs more submissions that study how genomes shape and produce new phenotypes in populations. As such, studies investigating how genes and genomes produce various complex phenotypes in African ecosystems are expedient.

During the 2019–2024 period, most biology papers submitted to the *SAJS* were primarily focused on South Africa, both in terms of the authors and the scope of the research. Overall, during this time, the Organismal Biology portfolio at *SAJS* reflects a commitment to advancing scientific knowledge across a broad spectrum of topics, fostering interdisciplinary collaboration, and promoting high-quality research with real-world applications.

The future of the field in South Africa and Africa

On the future of organismal biology in South Africa

In South Africa, organismal biology is a cornerstone of scientific inquiry, embracing diverse branches such as ecology, evolutionary biology, wildlife biology, biogeography, population ecology, and conservation. This expansive field is indispensable for unravelling the complexities of biodiversity, from the genetic level to entire ecosystems. Given our limited knowledge of Earth's biodiversity and the intricate relationships within natural ecosystems, there is no room for complacency – nature is perpetually in flux, and what we hold as true today may not stand tomorrow, especially in our era of rapid climate change and its profound effects on ecosystems and species.

Consider the plight of an emblematic species like the African elephant, whose migratory patterns are increasingly disrupted by shifting rainfall patterns and human encroachment. Without the meticulous work of conservation biologists, our understanding of these changes and how to mitigate their impacts would be severely limited. If this is the case for the elephant, how about less emblematic species such as amphibians, small mammals, reptiles, invertebrates, and countless microorganisms? Their essential roles in ecosystem health, encompassing functions, interactions, and vulnerabilities, frequently escape notice. Two decades into the 21st century, E.O. Wilson's poignant observation remains relevant: less than 1% of all named species have been studied beyond basic habitat preferences and diagnostic anatomy.[11]

This glaring knowledge gap underscores the pressing need for intensified research efforts in conservation biology. The urgency cannot be overstated. This field offers insights into addressing critical challenges such as species extinction, habitat degradation, fragmentation, and the complex impacts of climate change. This work is not merely about preserving Africa's unique ecological heritage; it is also about safeguarding livelihoods and guiding sustainable development in South Africa and across the continent.

Advancing the relevance of organismal biology

Several critical actions must be prioritised to amplify the influence and impact of organismal biology in South Africa and beyond. First, imagine a world where every species or ecosystem is meticulously monitored from space, and vast data sets are analysed in minutes instead of years. This is not science fiction; it is the reality that advanced technologies like satellite imaging and artificial intelligence (AI) can bring to conservation biology. We can enhance our understanding of ecosystem dynamics and species interactions by allocating resources to support cutting-edge research in genetics, remote sensing, and modelling techniques. For instance, AI can automate the analysis of camera trap images or acoustic recordings, identifying species and uncovering patterns in ecological data that might otherwise go unnoticed.

Second, the future of conservation biology rests with South Africa's young, tech-savvy generation. Imagine passionate students, guided by experienced mentors, venturing into the field to study endangered species and pioneer solutions for harmonious human-wildlife coexistence. These youths bring fresh perspectives and a deep commitment to environmental stewardship. To empower this next generation of conservation biologists,

robust academic programmes, mentorship initiatives, and hands-on field experiences are essential. However, achieving this vision is hindered when millions of young people in South Africa have never visited a national park. By engaging and inspiring young people in conservation efforts, we steer the interest and nurture future scientists and policymakers dedicated to environmental sustainability.

Third, fostering the relevance of conservation biology requires a harmonious blend of policy integration and community engagement. Imagine a roundtable where researchers, policymakers, and local community members unite to make inclusive decisions about research priorities, conservation approaches, and strategies. Strengthening these partnerships is crucial for ensuring that conservation efforts are equitable and effective. Incorporating local knowledge and community perspectives into research, planning, and policymaking promotes social equity and enhances the practical application of research and conservation insights.

Last, the investment and promotion of frontier research are increasingly crucial in conservation biology, especially in an era that prioritises the immediate applicability of scientific findings over exploration for the sake of discovery. We must purposefully support and invest in biological research that pushes boundaries. As Neil deGrasse Tyson once emphasised, while such discoveries may not yield immediate benefits today or in the foreseeable future, many innovations we enjoy today originated from what was once frontier research in past decades.

Critical research needs in Africa for ecology, conservation, and biodiversity

Critical research needs in Africa for ecology, conservation, and biodiversity encompass several essential areas. While substantial cutting-edge research is already being conducted on these topics, including significant contributions by African researchers, there remain critical research needs in Africa for advancing ecology, conservation, and biodiversity. First, there is a continuing pressing need to assess and monitor species diversity and ecosystem health using advanced methodologies such as remote sensing, DNA barcoding, and machine learning. Understanding the impacts of climate change on species distribution and ecosystem dynamics is crucial, as well as identifying and protecting critical biodiversity hotspots and corridors. Research on the interactions between invasive species and native flora and fauna is vital for developing effective management strategies.

Additionally, socio-ecological research integrating local knowledge and community engagement is essential for creating sustainable policies addressing human impacts and promoting biodiversity conservation. Collaborative efforts to build robust data-sharing platforms and comprehensive databases are also necessary to effectively support regional and global conservation efforts. These research needs, while already being addressed to some extent by ongoing studies in South Africa and other parts of Africa, require continued focus and expansion to fully enhance Africa's capacity to conserve its diverse biological heritage and promote sustainable development across the continent.

Final musings from the *SAJS* Associate Editor

As an Associate Editor of *SAJS* (S.M.), I see a significant rise in organismal research in South Africa, which speaks to the Journal's success over the last 120 years. I am happy to be part of this process and am grateful to all the authors (and reviewers) whose contributions to organismal biology have made this Journal what it is today. Many of my invited contributors have raised essential suggestions and perspectives about organismal biology and conservation in South Africa, with which I fully agree. I would also like to mention that journal editors and reviewers at *SAJS* continue to contribute extensively to the journal's growth. We achieve this through the review process and by being constructive, polite, respectful, friendly, rigorous, and timely. As an Associate Editor, I aspire to uphold these standards, whether asking authors for revisions, gently declining their work, or congratulating them on their exemplary contributions. In addition, as an interdisciplinary journal, the *SAJS* publishes articles palatable to a broad audience. Even though we publish articles for a wide audience, we seek methodologically sound articles that contribute to South African and African knowledge. I am excited and enthused to be a part of *SAJS* as it grows as an interdisciplinary journal and continues to publish quality research.

Declarations

S.M. is the *SAJS* Associate Editor for Organismal Biology. There are no competing interests to declare. There is no AI or LLM use to declare. All authors read and approved the final version.

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A view from the past: 120 years of palaeoscience in South Africa

Significance:

We provide a brief overview of the history and development of the palaeosciences from the perspective of the *South African Journal of Science*, highlighting key themes and future directions.

Introduction

Over the past century, South Africa has established itself as a global leader and research hub for the palaeosciences. The country is host to one of the richest collections of hominin remains on the planet – the Cradle of Humankind, globally recognised as a UNESCO World Heritage Site and the focus of extensive ongoing excavation. Indeed, a list of sites of international significance might be described as an embarrassment of riches, from the palaeontological discoveries in the Karoo Basin to world-renowned archaeological sites such as Sibhudu Cave and Pinnacle Point. The National Research Foundation's (NRF) Strategy for the Palaeosciences encapsulates the importance of the field[1] and emphasises the strong geographical advantage of the palaeosciences in South Africa. It is within this broader context that the *South African Journal of Science* (*SAJS*) finds itself. Since its inception, *SAJS* has enjoyed strong local and international support from the palaeoscientific community, and continues to publish on new developments, discoveries and debates within the field. In this article, we reflect on the status of the palaeosciences in South Africa, briefly reviewing historical and recent highlights in the field from the perspective of the *SAJS*. In keeping with uniformitarian principles, we then consider the future trajectory of the discipline in the national context, and how this might be informed by our past.

The historical development of the palaeosciences in South Africa

Since its inception in 1903, the *SAJS* has been a home for palaeoscience research, including an early description of stone tools from the Albany Museum collection[2], followed by similar articles over the next few years. The broader field received a boost with the discovery of the Taung Child in 1924, and the increase in local interest in this science is evident in the very many articles on archaeology and our earliest ancestors in the volumes published following the discovery and over the course of the next century. Human evolution research has remained prominent throughout the Journal's history, covering advances at Swartkrans[3], Sterkfontein[4–6], and later Drimolen[7], amongst many others. Such developments in palaeoanthropology have garnered significant interest at local and international levels and remain some of the most well-cited within the *SAJS* 'Archaeology, Anthropology and Palaeontology' portfolio, hereafter grouped under the umbrella of palaeosciences for brevity.

Since those early published studies on stone implements, archaeological research yielding insights into technological advances and cultural development of modern humans has flourished. Coastal cave sites, for example, have contributed to our understanding of Middle Stone Age advancements, including the valuable multidisciplinary approach employed at Sibhudu and Border caves.[8–10] These 'marvellous millennia', as Wadley described them in 2015[11], have been presented and argued for in the pages of *SAJS*, and through these publications their significance in human social development has been demonstrated.

South African scientists have taken a leading role in the development of the isotope sciences and their application within the palaeosciences. In particular, Vogel and colleagues helped establish the regional distribution of C_3 and C_4 grasses across South Africa and implications for isotope research[12,13], helping to lay the foundation for future applications to understanding palaeodiet[14,15], and palaeoenvironments[16]. Isotopes were later applied to a stalagmite series from the Makapansgat Valley to yield first insights into regional temperatures during important global climate events, namely the Little Ice Age and Medieval Climate Anomaly.[17,18] The field continues to thrive, and is currently serviced by laboratories at the University of Cape Town, iThemba, and the University of Pretoria. The establishment of an Accelerator Mass Spectrometer and associated cosmogenic nuclide capabilities at iThemba is an important addition to these facilities[19,20], making dating more accessible and affordable for local scientists.

A decade of palaeosciences at *SAJS*: 2014–2024

To obtain an overview of recent developments in the palaeosciences published in the *SAJS*, we collated 'front-section' and Research Article titles published within the Archaeology, Anthropology and Palaeontology portfolio for the period 2014–2024. We then reviewed prominent themes and keywords occurring within the article titles. This exercise revealed a strong bias towards palaeoanthropological themes, with a slightly lesser focus on archaeology and palaeontology. Quaternary palaeoclimatic and palaeoenvironmental themes are rather lacking. Such imbalances may stem from a tendency for certain fields to publish in more specialist or international journals, or may relate to the sheer volume of research associated with understanding human evolution. Nevertheless, a review of the past decade of the Journal's archive shows that the SAJS is generally well supported by the palaeoscience community, including many original research articles but also many commentaries and other front-section articles highlighting key debates in the field. These submissions include a high proportion of international authors and multinational and multidisciplinary research teams, reflecting positively on the health of the discipline and the standing of the Journal. In a nod to the historical importance of the Journal as a venue for early research, we also see authors returning to the Journal to publish the results of renewed excavations following up on early publications from the same site (e.g. Bader and Will[21]).

In 2015, we saw one of the most exciting recent developments in human evolution research, the description of a new hominin species, *Homo naledi*, from the Dinaledi Chamber of the Rising Star cave system by Lee Berger and colleagues[22]. Laudably, the scientific process, from excavation of this rich fossil assemblage through to analysis, was openly shared on social media[23] and garnered wide public interest. In the words of Randolph-Quinney[24(p.1)], these scientific developments "definitely put South African palaeoanthropology back on the world stage, and more importantly, encouraged the public to engage directly with the science". Like many scientific discoveries, research on *Homo naledi* has been subject to its fair share of debate[24–28] and controversy[29], particularly regarding the widely publicised mortuary behaviour of this small-brained hominin.

A fascinating emerging theme describes ichnofossil remains preserved in Pleistocene aeolianites created by a diverse suite of probable trackmakers, including giraffe[30], reptiles[31,32] and indeed hominins[33,34]. Reaching much further back in time to the Jurassic, ichnological investigations have revealed tiny theropod dinosaur trackways[35], and, with the aid of field measurements and 3D modelling, were used to estimate such technical parameters as step length, stride, and speed.

Another rapidly developing technique is the extraction of ancient DNA from archaeological specimens in what Morris described in 2015 as "a rush for knowledge in a new field"[36(p.1)]. This work progressed from analysing a subset of genetic information such as that contained within mitochondrial DNA, to full genome sequencing, yielding potential to understand population genetics of prehistoric individuals (e.g. Lombard et al.[37]). As available databases of modern human DNA continue to grow, so too does our ability to not only understand and ask questions around human ancestry[38], but also to make comparisons with ancient genetic material, lending insight to archaeological studies.

The future of the palaeosciences in *SAJS*

Juxtaposed against a rich history of origins science is a growing awareness of the lingering impact of colonial practices, and the need to redress the imbalances of the past through careful and reflexive scientific conduct and engagement, and ethical practice (e.g. Sealy[39]). Issues around parachute science, a broad term for power imbalances between researchers from the Global North and South, still persist, as do passport privileges[40] and other forms of inequality in what is also an often male-dominated field. Importantly, the conversation around these critical issues has opened, with growing awareness and recognition of their impact, and initiatives to improve the way we do science.

Targeted funding initiatives for the discipline have begun to tackle imbalances in the field by supporting transformation, science communication and engagement initiatives. These include, among others, the NRF African Origins Platform, and GENUS Centre of Excellence for the Palaeosciences.[41] The Palaeontological Scientific Trust (PAST), a local NPO, has been a strong advocate for the palaeosciences that supports capacity building of the next generation of Stone Age researchers, and educational outreach through the Walking Tall Educational Theatre Project.[42] International teams now commonly invite applications from African postgraduate students to participate in archaeological digs (e.g. the HOMER Project). Such networking and training opportunities promote inclusivity by opening doors for local students who may lack field exposure, travel opportunities or the chance to connect with established scientists and students from other countries. Ongoing engagements and collaborations hopefully will lead to further advancements in skills transfer as well as other support structures to foster student pathways throughout their university careers, such as providing funds, research materials, and infrastructure support.

In a country where deep historical divisions persist, origins science may have a growing role as a unifying lens for humanity, embodied in the PAST All From One™ movement: "All told, you will see that shared origins is a potent force for tolerance, unity, collaboration and conservation."[43] *SAJS* will continue to support these important conversations, and scientific advances, as we move towards a deeper understanding of our past.

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Declarations

J.M.F. is the *SAJS* Associate Editor and T.F. is the *SAJS* Associate Editor Mentee for Archaeology, Anthropology and Palaeontology. There are no competing interests to declare. There is no AI or LLM use to declare.

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The South African Statistical Association and its role in science in South Africa

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Significance:

The South African Statistical Association (SASA) turned 70 years old in 2023, having made huge impacts in South Africa and beyond. Through SASA, the statistics community in South Africa has made significant strides in the field, both locally and internationally, ensuring the importance of the discipline is concreted into the academic and industry playing fields. The statistics community continues to grow and remains passionate about growth and development of school learners, undergraduate and postgraduate students, academics and statisticians in industry. The opportunities for statisticians in South Africa are endless, and important to the economic sustainability of South Africa. This paper provides an historical overview of the impacts of the South African Statistical Association and statistics in South Africa.

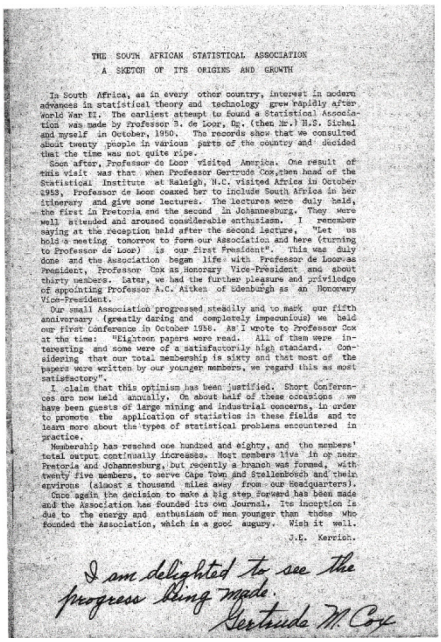
Introduction

The South African Statistical Association (SASA) was founded in 1953, specifically on 28 October 1953. The formation of the association occurred at a gathering at the University of the Witwatersrand when Gertrude M. Cox was visiting from the University of North Carolina, on invitation from John Kerrich. Present were founding members Cox, de Loor, Kerrich, Sichel, Arbous, Maritz, Abraham, Cristensen, Adelstein, Krige, Armsen, Lutz, and Steyn.[2] The first Secretary was Maritz, with President de Loor, Vice-President Kerrich, Honorary President Cox and other Executive Members Sichel, Arbous and Steyn.[2]

On the occasion of the 25th anniversary of SASA, Prof. H.S. Steyn provided an overview of the founding years of statistics in South Africa.[2] Already in the 1930s, statistics began its growth through four South African doctoral students who studied in the UK, all having previously studied at Stellenbosch University, namely Muller, Pretorius, le Roux and Gonin. However, most statistics occurred in the Mathematics departments up to the 1950s, with the first Department of Statistics founded at the University of Pretoria by Prof. B. de Loor who obtained his doctorate in algebra under Bouwer.[2] Figures 1 and 2 are extracts from the first Vice-President and first Secretary of SASA, presented in the 2003 SASA conference 50th celebration booklet.[3]

In the first public meeting of SASA on 18 May 1954, a significant growth towards statistics as a field was discussed by de Loor[2]:

> *A comparatively new branch of scientific method has come into its own, and is permeating all phases of research, industry and organisation. This new branch, which is the scientific expression of logical induction, is the statistical method. Its development has been phenomenal, especially during the last two decades. To express it in terms of modern physics, a chain reaction has been set up and is making its influence felt in nearly every sphere of human activity.*



THE SOUTH AFRICAN STATISTICAL ASSOCIATION
A SKETCH OF ITS ORIGINS AND GROWTH

In South Africa, as in every other country, interest in modern advances in statistical theory and technology grew rapidly after World War II. The earliest attempt to found a Statistical Association was made by Professor B. de Loor, Dr. (then Mr.) H.S. Sichel and myself in October, 1950. The records show that we consulted about twenty people in various parts of the country and decided that the time was not quite ripe.

Soon after, Professor de Loor visited America. One result of this visit was that when Professor Gertrude Cox, then head of the Statistical Institute at Raleigh, N.C. visited Africa in October 1953, Professor de Loor coaxed her to include South Africa in her itinerary and give some lectures. The lectures were duly held, the first in Pretoria and the second in Johannesburg. They were well attended and aroused considerable enthusiasm. I remember saying at the reception held after the second lecture, "Let us hold a meeting tomorrow to form our Association and here (turning to Professor de Loor) is our first President". This was duly done and the Association began life with Professor de Loor as President, Professor Cox as Honorary Vice-President and about thirty members. Later, we had the further pleasure and privilege of appointing Professor A.C. Aitken of Edenburgh as an Honorary Vice-President.

Our small Association progressed steadily and to mark our fifth anniversary (greatly daring and completely impecunious) we held our first Conference in October 1956. As I wrote to Professor Cox at the time: "Eighteen papers were read. All of them were interesting and some were of a satisfactorily high standard. Considering that our total membership is sixty and that most of the papers were written by our younger members, we regard this as most satisfactory".

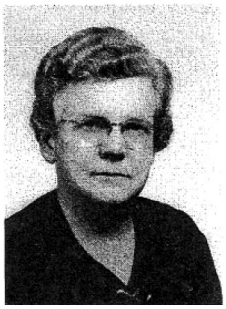
I claim that this optimism has been justified. Short Conferences are now held annually. On about half of these occasions we have been guests of large mining and industrial concerns, in order to promote the application of statistics in these fields and to learn more about the types of statistical problems encountered in practice.

Membership has reached one hundred and eighty, and the members' total output continually increases. Most members live in or near Pretoria and Johannesburg, but recently a branch was formed, with twenty five members, to serve Cape Town and Stellenbosch and their environs (almost a thousand miles away from our headquarters).

Once again the decision to make a big step forward has been made and the Association has founded its own Journal. Its inception is due to the energy and enthusiasm of men younger than those who founded the Association, which is a good augury. Wish it well.

J.E. Kerrich.

I am delighted to see the progress being made.
Gertrude M. Cox



Professor Gertrude M Cox was a visitor to South Africa, and it was in part the enthusiasm sparked by her visit that precipitated the first meeting; she was elected Honourary President.

Figure 1: Message from John Kerrich, the first SASA President, and Gertrude Cox, Honorary President.[3]

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☐ Supplementary material

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Message from a Founding Member

Prof JS Maritz

My recollections of the founding and early days of the Association are offered with some diffidence because I lost contact with it in 1960. They are hazy. After all, it did happen 50 years ago! Fortunately I can refer to the excellent review, by Professor H S Steyn, of the early history of Statistics in South Africa and especially of the founding of the Association. Its title is "When the South African Statistical Association was founded", appearing in the SASJ of 1979.

I recall the formation meeting of the Association as quite small, and it is perhaps of interest to list again the names of those present, in alphabetical order: G Abraham, A M Adelstein, A G Arbous, P Armsen, P Christensen, Gertrude M Cox, B de Loor, J E Kerrich, D G Krige, W Lutz, J S Maritz, H S Sichel, H S Steyn. Professor Gertrude M Cox was a visitor to South Africa, and it was in part the enthusiasm sparked by her visit that precipitated the first meeting; she was elected Honourary President. The first President was B de Loor, Vice-President J E Kerrich.

I was the first Secretary/Treasurer, and despite my total lack of experience and competence for the job, the Association survived. A happy circumstance, for me, was that Committee meetings were held alternately at my home, and at Halfway House. This is, of course, a subjective impression, but the list of South African names above says something about the flavour of the Association, and about the emphasis of Statistics in South Africa at the time. I think it would be fair to say that none of those persons was concerned only with the Mathematics of Statistics, all of them were with the applications of Statistics; at least two of them were not Statisticians at all, but very serious users of statistical techniques. I am tempted to put D G Krige in this latter category, but he has become perhaps the most famous of all South African statisticians. I think we were enthused by the potential for application of statistical thinking in so many diverse areas. And the insight of many scientists, engineers and other professionals who understood the need for statistical expertise must be acknowledged.

On a personal note, Kerrich and Sichel were my introduction to Statistics as a discipline, Dr C H Wyndham, Head of the Applied Physiology Laboratory of the Chamber of Mines greatly influential for my appreciation of the worth of applied statistics.

From a small beginning the association has flourished to become a vigorous representative of statistical activity in SA. It has encouraged both theoretical developments and professional application of statistical methods. May it continue to do so for many years.

Figure 2: Message from J.S. Maritz, the first SASA secretary.[3]

From these strong beginnings, SASA has continued to grow, and, in 2023, was 70 years old. The current membership of SASA sits at 856, including students. The mission of SASA is to foster the study and knowledge of statistical theory and its application towards improving the quality of life of all South Africans. The statistical community in South Africa has a rich history and a strong sense of community.

SASA's recognition of the community

Fellows and Honorary Members

SASA recognises exceptional contributions to the advancement of statistics in the profession and academia through honorary appointments and awards. Each year, SASA Members can be nominated for an Honorary Member appointment and/or a Fellow appointment. Nominated Honorary Members are retired members and are awarded life-long membership based on their exceptional contributions to the overall knowledge base of statistics or the advancement of the Association. Any enfranchised SASA Member can be nominated and appointed as a Fellow by means of outstanding contributions to the field. Each year, both the Honorary Member(s) and Fellow(s) are selected by the Fellowship Committee, which is composed of the last six available Past Presidents.

Nomination for an Honorary President of SASA can be made for a Member who has made exceptional contributions to the advancement of the profession of statisticians in South Africa. This appointment is made by a unanimous decision of the SASA Executive Committee. At the 2007 50th Annual Conference, the (then) Statistician-General, Mr Pali Lehohla, was awarded the position of Honorary President of the Association. This award was given in recognition of his efforts to promote a broad appreciation of statistics among government, business, civil society, and the general public.

In 2013, the inaugural SAS Thought Leader award, sponsored by SAS South Africa, was awarded. This annual award is given to someone who has significantly influenced the South African statistical community through a variety of activities and has made notable contributions in academia, industry, government, and other sectors. The criteria for this recognition include contributions to and impacts in leadership, knowledge generation, and human capital development; the impact of their work and research; and success in attracting funding. The list of Honorary Members, Fellows, and Thought Leaders is available on the SASA website (www.sastat.org).

The Herbert Sichel Medal

The Herbert Sichel Medal was first instituted by SASA in 1997 in memory of Prof. Herbert Sichel, one of South Africa's statistical pioneers, who made seminal contributions to statistics in fields ranging from mining to statistical linguistics, including a distribution named after him. A special edition of the *South African Statistical Journal* (Vol.31 No.1) in memory of H.S. Sichel appeared in 1997.

Except for one year (2001), the Medal has been awarded annually to a member (or members) of the Association whose paper appeared (in print or online) during the previous calendar year and was judged best by a panel of judges appointed by the Association. A list of winners of the Award since its inception in 1997 appears on the SASA website. In evaluating the papers for the Medal, the panel uses the following set of criteria: (1) the impact of

the paper in its specific field; (2) how innovative the ideas or techniques used in the paper are; (3) the relevance of the problem being addressed; and (4) how well written the paper is.

The South African Statistical Journal

The *South African Statistical Journal* (SASJ) is the official journal of SASA and was founded during the mid-1960s, following the formation of SASA in 1953. Under the editorship of Prof. D.J. Stoker, assisted by Prof. H.S. Steyn and Prof. C.F. Crouse, the first issue of the SASJ was published in 1967. This issue also contains a narrative on the establishment of SASA, written by the SASA President at the time, Prof. J.E. Kerrich. SASJ quickly attracted international attention, with the first article by an author from abroad being published in the second issue.

SASJ publishes biannually, in March and September, with the aim of providing a platform for innovative contributions to the theory and application of statistics. The journal employs a double-anonymous peer-review process, where reviews are conducted by local or international, independent and anonymous experts. The founding of SASJ not only provided the South African statistics community with a local platform for publishing, but also with possible career advancement opportunities in terms of editorial and peer review duties.

SASJ is accredited by the Department of Higher Education and Training of South Africa. The journal is currently indexed on Scopus and in the Web of Science Emerging Sources Citation Index. Some of the most recent developments for SASJ include the journal becoming a free-of-charge, fully open access journal from 2022 and moving to a paperless publication model from 2024.

The Statistical Dictionary

The translation of statistics terminology from English to Afrikaans has been a significant project for the South African statistics community. The first edition of the *Statistical Dictionary* was published in 1961 by de Loor, one of SASA's founders, and *a 2nd edition* was published in 1965 under the Suid-Afrikaanse Akademie vir Wetenskap en Kuns.[4] A *revised and enlarged version* was published under the leadership of Prof. H.S. Schoeman with the Department of National Education's Translation Bureau in 1984 (Figure 3).[5] A further *update* was published in 2009 by Faans Steyn, Chris Smit and Corna Vorster, and made available online.

The list of statistical terms currently consists of approximately 7200 entries. It is not only an English–Afrikaans glossary but also contains contexts or sentences in which the terms occur, sometimes with brief definitions. A division was made into subfields within the subject field in the context, and an adapted list of codes from Statistical Theory and Methods Abstracts was used. The existing *Statistical Dictionary* was integrated with the list and is given as such under "Source publication". Future endeavours by SASA involve translating statistical terms into all South African languages. A publication by Stats SA in 2013 has set this plan into action. This dictionary covers terms used in reporting statistics.

Connections in the statistics community

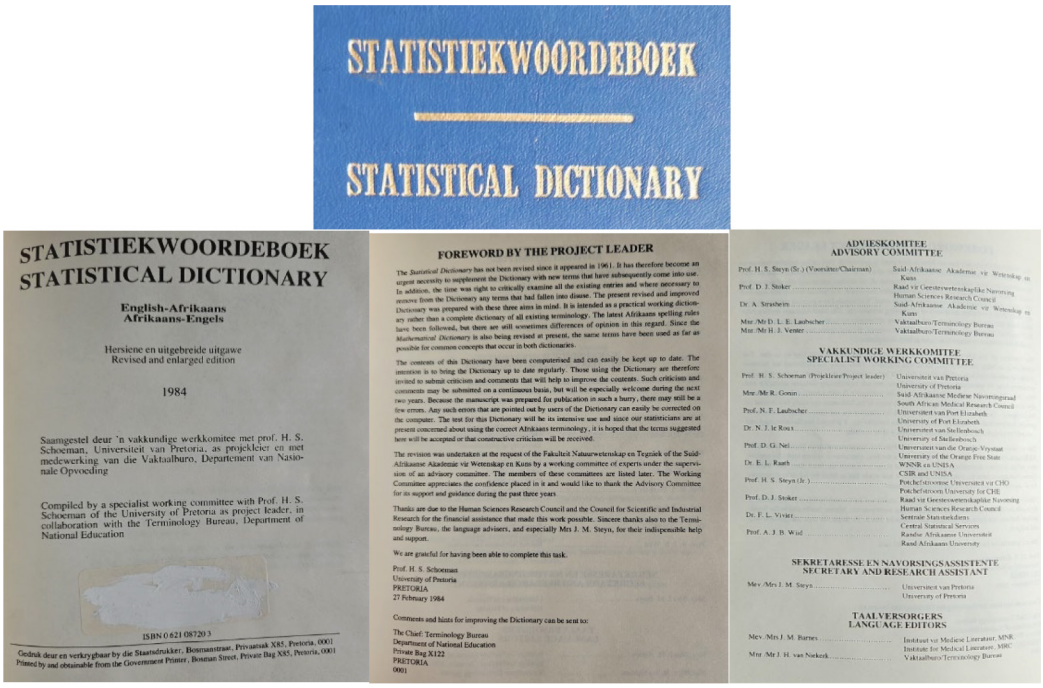
Statistics South Africa

Statistics South Africa (Stats SA) is the national statistical agency responsible for collecting, producing, and disseminating official statistics in South Africa. Its history dates to the Central Statistical Service, which was transformed into Stats SA, with the name change occurring in 1998. The Central Statistical Service was initially the statutory agency responsible for national statistics in South Africa, but after the 1994 elections, the new government inherited a significant void in statistical information, particularly amongst the previously disenfranchised majority, making it difficult to benchmark progress or make informed decisions.

To address this void, the Central Statistical Service underwent a transformation, reviewing and re-engineering its statistical series, as well as transforming its human capacity and statistical infrastructure. This transformation led to the creation of Stats SA, a national government department with a new mandate and role derived from the *Statistics Act (Act No.6 of 1999)*.

Since then, Stats SA has been responsible for producing official statistics, as well as coordinating other statistics produced in South Africa by market research companies, parastatal bodies, government departments, universities, research institutions, and the private sector, amongst others.

Stats SA has also been actively involved in various African initiatives aimed at improving the relevance and quality of statistics on the continent, such as the African Charter on Statistics and the Strategy for the Harmonisation of Statistics in Africa (SHaSA), as well as broader


STATISTIEKWOORDEBOEK

STATISTICAL DICTIONARY

STATISTIEKWOORDEBOEK
STATISTICAL DICTIONARY

English-Afrikaans
Afrikaans-Engels

Hersiene en uitgebreide uitgawe
Revised and enlarged edition

1984

Saamgestel deur 'n vakkundige werkkomitee met prof. H. S. Schoeman, Universiteit van Pretoria, as projekleier en met medewerking van die Vaktaalburo, Departement van Nasionale Opvoeding

Compiled by a specialist working committee with Prof. H. S. Schoeman of the University of Pretoria as project leader, in collaboration with the Terminology Bureau, Department of National Education

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FOREWORD BY THE PROJECT LEADER

The *Statistical Dictionary* has not been revised since it appeared in 1961. It has therefore become an urgent necessity to supplement the Dictionary with new terms that have subsequently come into use. In addition, the time was right to critically examine all the existing entries and where necessary to remove from the Dictionary any terms that had fallen into disuse. The present revised and improved Dictionary was prepared with these three aims in mind. It is intended as a practical working dictionary rather than a complete dictionary of all existing terminology. The latest Afrikaans spelling rules have been followed, but there are still sometimes differences of opinion in this regard. Since the *Mathematical Dictionary* is also being revised at present, the same terms have been used as far as possible for common concepts that occur in both dictionaries.

The contents of this Dictionary have been computerised and can easily be kept up to date. The intention is to bring the Dictionary up to date regularly. Those using the Dictionary are therefore invited to submit criticism and comments that will help to improve the contents. Such criticisms and comments may be submitted on a continuous basis, but will be especially welcome during the next two years. Because the manuscript was prepared for publication in such a hurry, there may still be a few errors. Any such errors that are pointed out by users of the Dictionary can easily be corrected on the computer. The test for this Dictionary will be its intensive use and since our statisticians are at present concerned about using the correct Afrikaans terminology, it is hoped that the terms suggested here will be accepted or that constructive criticism will be received.

The revision was undertaken at the request of the Fakulteit Natuurwetenskap en Tegniek of the Suid-Afrikaanse Akademie vir Wetenskap en Kuns by a working committee of experts under the supervision of an advisory committee. The members of these committees are listed later. The Working Committee appreciates the confidence placed in it and would like to thank the Advisory Committee for its support and guidance during the past three years.

Thanks are due to the Human Sciences Research Council and the Council for Scientific and Industrial Research for the financial assistance that made this work possible. Sincere thanks also to the Terminology Bureau, the language advisers, and especially Mrs J. M. Steyn, for their indispensible help and support.

We are grateful for having been able to complete this task.

Prof. H. S. Schoeman
University of Pretoria
PRETORIA
27 February 1984

Comments and hints for improving the Dictionary can be sent to:

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Figure 3: The *Statistical Dictionary*.[5]

initiatives within the United Nations, which included hosting the very first UN World Data Forum in 2017 as well as leading the UN Committee on experts on big data and data science for the production of official statistics.

The organisation has also been pursuing an Integrated Development Framework, with the aim of reporting on global, continental, regional, and national development agendas and serving as a tool to identify data gaps, eliminate duplication of data, prioritise strategic statistical needs, and ensure the quality of data for evidence-based decision-making.

The following history is extracted from an unpublished conference booklet[3]: Statistics in South Africa has a number of significant milestones. From the early beginnings, covering the census data from 1910 to 1914, the collection of official statistics in South Africa dates back to the pre-Union period when the four former colonies collected data for administrative purposes. The *South Africa Act of 1909* provided for a census of the white population, for election planning, at four-year intervals. The *Census Act of 1910* provided that a census be held in 1911, and thereafter at such intervals as decided on by the government. For this purpose, a Census Office was established in 1910. It was directed by J.B. Moffat from its inception in 1910 to 1914.

Into the census and statistics from 1917 to 1939, the scope of statistical data collection saw the *Statistics Act 38 of 1914* passed. The Act provided for the collection and publication of a wide range of social and economic statistics and the establishment of an Advisory Statistical Council. The Statistics Council provided important input to the production of statistics before the establishment of the first fully fledged statistical agency in the country. The outbreak of World War I prevented promulgation of *Act 38 of 1914* until 1 April 1917, on which date the Office of Census and Statistics was established as a division in the Department of the Interior. C.W. Cousins was the first director of the Office, a position he held until 1924.

Dr J.E. Holloway succeeded Cousins in 1925 and remained in office until 1933 when he was succeeded by A.W. Curruthers (1934–1939). During this period, a number of interesting 'firsts' took place: the country's annual agricultural production was assessed; the country's international balance of payments and its national income were calculated; improved statistics were collected in respect of employment, unemployment, wages and trade unions (after the establishment of the Department of Labour in 1924); statistics on road vehicle accidents were first collected in 1934; and, in 1936, family expenditure was collected – thus laying the foundation for the calculation of the consumer price index.

From World War II and the immediate post-war period, 1939–1950, the agency was directed by Dr E.G. Malherbe (1939–1945). He was succeeded by E.P. Pearce (1945–1946). Initially, the War restricted the extension and improvement of statistical services. Towards the end of the War, conditions had improved and statistics on new areas were being collected. However, by the early 1950s, government called for a thorough assessment of statistical production, and, in 1951, a Report of the Committee of Inquiry into Public Statistical Services in the Union reported "that in many respects the present Statistical Service does not differ materially from that of a quarter century ago, and that the Service of 1926 cannot cope with the requirements of 1951". At that time, the agency consisted of nine departments ("administration, population, industries and agriculture, social, machine tabulation, calculation work, publications and library, distribution and national accounts"). It had 161 permanent and 367 temporary staff members. It indicates that two of the temporary staff members were "natives".

One of the main problems identified by the commission was "the lack of coordination between the Bureau and the different Government departments and semi-government bodies which collect statistics. This lack of coordination is closely bound up with the lack of status and trained statistical personnel in the Bureau itself, which has considerably hampered the development of the statistical services." The Committee recommended that the professional level of the agency be raised and that it be granted independent status under the Minister of the Interior.

An interesting publication relating to the period 1951 to 1994 was Union Statistics for Fifty Years, a jubilee issue presenting tables on about 50 years of statistics. This period corresponds with the coming to power of the National Party and the application of its apartheid policies. In the field of statistics, these policies were particularly noticeable in the fragmentation of data collection in the country due to the establishment of ten homelands for Africans. During this period, the agency had the following heads: J.I. Raats (1946–1956), H.M. Stoker (1956–1965), J.J. Botha (1966–1971), T. du Plessis (1972–1980), A. Louw (1981–1984), Dr S. Thirion (acting 1984) and T. du Toit (1985–1995).

The period from 1995 to 2003 was marked by a dramatic reorganisation of the agency and the reinstatement of country-wide data collection. In this regard, the biggest challenge was Census '96 which was planned and implemented under the leadership of F.M. Orkin who became the first head of the agency in the post-apartheid era, and he prepared for a modern Statistics Act. The Census of 1996 was headed by Pali Lehohla, who later became the Statistician-General under the new Act.

Orkin was succeeded by the first Statistician-General, and the first black person to head the agency in 90 years, when Pali Lehohla took over the reins in November 2000. Lehohla set himself the task of improving the body of data collected by the agency; creating a spatial frame for the data (geography); creating an infrastructure and architecture for the collation, management and dissemination of information; and establishing the institutional framework within which the collection and production of that data and information could take place (the National Statistics System). Furthermore, during Lehohla's period in office, staff appointments, particularly at senior management level, reached levels which approximately represented the demographics of the population of the country.

The Council for Scientific and Industrial Research

Constituted by an Act of Parliament in 1945 (*Act 33 of 1945, Act 46 of 1988 as amended by Act 71 of 1990*), the Council for Scientific and Industrial Research (CSIR) is one of the leading scientific and technology research, development and implementation organisations in Africa. With a track record spanning more than 80 years, the organisation is committed to serving the development objectives of South Africa and improving the quality of life of its people.

The CSIR was established post World War II and therefore initially focused more on warfare, radar technology and security and defence for the country. Acting Prime Minister Hofmeyr was quoted as saying[6]: "A nation which neglects research is at the same time impairing its prospects of material welfare and weakening its status and dignity among the civilised nations of the world." Hence fields such as Operations Research was one that first blossomed at the CSIR.

The National Research Institute for Mathematical Sciences (NRIMS) was first established in 1961 as part of the CSIR, which helped create an Operations Research group and a Statistical group. During the late 1960s and early 1970s, several Operations Research and Statistics Departments were created at universities, which attracted a number of the Operations Researchers and statisticians from CSIR to head these departments at the universities.[7]

CSIR has since been involved in a number of applications of statistics, but perhaps one of the most recognised and ongoing models developed was the CSIR Elections Prediction Model.

The South African Medical Research Council

The South African Medical Research Council (SAMRC) was established by the South African government under *Act No.19 of 1969*. Initially, the Biostatistics Research Unit was initiated as a support service to support the design and data analysis of various research projects within the SAMRC, as well as capacity development and postgraduate supervision at local universities in proximity to the respective regional centres. Then, in the mid-1990s, it was absorbed into the Centre for Epidemiological Research in South Africa. However, due to its strategic importance within the SAMRC and the broader health science community, it was reconstituted into an independent unit. Now the Biostatistics Research Unit is a multi-centre research facility within the SAMRC for biostatistical expertise in evaluating public health strategies, developing statistical

methods, and interpreting biomedical studies. The Unit has expertise in biostatistics, GIS, data management and food science and has strong collaborations with diverse research groups including clinicians, epidemiologists, health service researchers, and public health policy researchers within and external to the SAMRC. The Unit has three regional offices: Cape Town, Pretoria, and Durban. There are five key methodological research programmes within the Biostatistics Research Unit's Biostatistics Division: The design and analysis of clinical trials; Causal inference; Longitudinal data analysis; High dimensional analysis; and Spatial analysis. The SAMRC Biostatistics Research Unit is a highly collaborative unit and has played a pivotal role in several papers published in *SAJS*.

The South African Council for Natural Sciences Professions

The South African Council for Natural Sciences Professions (SACNASP) is mandated by the *Natural Scientific Professions Act, 2003 (Act 27 of 2003)* to register practising natural scientists in one of various fields of practice. The natural sciences encompass a wide range of scientific fields, covering all the basic sciences and many of their applied derivatives. Statistical Science is one of 26 fields of practice gazetted in the amended schedule I of the *Natural Scientific Professions Act* (Notice 469 of 2021). SASA and ICCSSA were instrumental in adding Statistical Science as a field of practice in 2015. Prior to 2015, statisticians could only register as professional scientists under the Mathematical Science field of practice. However, Mathematical Science does not cover and accommodate proper governance in the practice of Statistical Science. Specifically, while the applied sciences and engineering would be expected to understand and interpret statistical reports, they are not necessarily trained in the fundamentals of statistical methodologies such as the theories and applications of design of statistical experiments, inferential techniques, prediction and forecasting, multivariate analyses, quality control and sampling methods (both in the Bayesian and classical paradigm). Therefore, it was necessary to have Statistical Science as a field of practice under SACNASP for professional registration, regulation and continued professional development of practising statisticians in South Africa.

The Institute for Certified and Chartered Statisticians of South Africa

Towards the end of 2008, Mr H. Gabriels (Chair of the Statistics Council), Dr H. van Rooy (SASA President), and Dr V. Micali (independent) met to work on an initiative to create a professional association.

This association would be affiliated with SASA to coordinate the statistical profession in South Africa and, at the same time, to assure legal compliance. A general assembly of statisticians in industry got together on 22 January 2009 to commence this initiative. That assembly mandated an elected team to constitute an associated society to SASA, in the form of an Institute governed by the SASA Constitution and its own by-laws and compliant to SACNASP. Mr H. Gabriels was elected Chair of the task team. The task team made detailed proposals on the amendments to the SASA Constitution. The main proposal was to amend the constitution to allow an Associated Society to register with SASA. It was further proposed that the Institute for Certified and Chartered Statisticians of South Africa (ICCSSA) be recognised as an associated society. Following extensive consultations between Mr A.J. De Klerk, the representative of SACNASP, on the relationship with SACNASP, it was agreed that SASA and ICCSSA would apply to register as a voluntary association with SACNASP.

The ICCSSA was launched on 13 June 2011 by the Hon. Min. Trevor Manuel as the essential body for practising statisticians. The main purpose of ICCSSA was to (1) provide professional recognition and registration for practising statisticians in the industry, (2) improve the competency of members and other statisticians through the provision of Continuous Professional Development activities for members, and (3) create a Community of Practice for statisticians in industry.

The incorporation of ICCSSA as an associated society of SASA enabled collaboration for the support of both academic and practising statisticians in South Africa. This was facilitated through representation of each organisation at the ICCSSA Board or SASA executive meetings. ICCSSA has been recognised by the South African Qualification Authority (SAQA) as the voluntary statistical professional body in South Africa since 19 February 2014 for the purposes of the *National Qualifications Framework (NQF) Act, Act 67 of 2008*, and SAQA approved the registration of the Chartered Statistician (ChM) and Certificated Statistician (CeM) for professional designations on the NQF. ICCSSA operated as a non-profit company and was registered with CIPC up until 2023. From 2024, the role of practising statisticians has lied with SACNASP.

On 17 August 2015, Statistical Science was gazetted to be included as a field of practice under Schedule 1 of the NSP Act in South Africa, separating statisticians from mathematical scientists and concreting the identity of a statistician in South Africa.

The Agricultural Research Council

The Agricultural Research Council (ARC) is a statutory parastatal body established in terms of the *Agricultural Research Act, 1990 (Act 86 of 1990)*. It is the principal agricultural research institution in South Africa. The ARC was established during 1992, and has a rich history. The ARC Biometry Unit provides a statistical consultation service that contributes to research in areas as diverse as biological pest control, animal production, nutrition, crop production, and breeding analysis programmes. Biometricians are successful in integrating their statistical expertise into research programmes, ensuring efficient scientific research. They ensure that information is fully utilised and scientifically viable. Through the services offered, the experienced team has established a reputation as a specialist team in South Africa.

The Statistics Council

The South African Statistics Council (https://council.statssa.gov.za/) is an independent advisory body that advises the Minister, the Statistician General, or an organ of state which produces statistics on matters pertaining to the promotion and safeguarding of official statistics, the coordination of statistical activities, and an environment which is supportive of the collection, production, dissemination and use of official statistics. Therefore, the Council is not a board, nor is it the Stats SA Council.

The Council appoints different committees as are necessary for the effective performance of the functions of the Council. Currently, the following committees in which members and relevant Stats SA managers dig deeper into specific issues, are the Population and Social Statistics Committee, Economic and Labour Statistics Committee, Methodology and Innovation/ICT Committee, and Strategy Committee.

The Minister, after consultation with the Cabinet, appoints the Members of the Council from nominations obtained. The Council consists of 18–25 members with relevant professional proficiency and interest, broadly representative of groups or interests concerned with the production and use of official statistics, of whom nine must be persons representing the respective provinces. The following SASA Members have served on the Council: Dawie Stoker up to 2003, Jacky Galpin up to 2018, Khangelani Zuma 2008–2018, Maseka Lesaoana 2008–2018, Tertius de Wet 2003–2008, Nico Crowther 2003–2008, Daan de Waal 2003–2008, Sarah Radloff 2013–2018, Sulaiman Salau 2013–2018, and Ariane Neethling 2013–current.

The Institute for Statistical Research

The following history is taken from the unpublished conference booklet.[3] The Institute for Statistical Research (ISR) has been one of the institutes of the Human Sciences Research Council (HSRC) since its inception. Prof. D.J. Stoker took over as Director of the ISR from Dr Japie Kies during 1979, firstly on a part-time basis and from 1981 on a full-time basis. After Stoker's appointment as Vice-President of the HSRC in July 1982, Prof. Nico Crowther from the University of Port Elizabeth was appointed as director of the ISR and he acted in this capacity from 1983 until 1990. For the subsequent 18 months until June 1992, D.J. Stoker, who had retired at the end of 1989, again took up this responsibility on a temporary basis. From July 1992, Stoker continued his involvement with the HSRC as a statistical consultant for several more years. Over

the period 1981–1990, the number of qualified statisticians in the ISR increased to 15. However, due to the necessity to rationalise caused by the government's requirement that Research Councils must increasingly earn their own income by undertaking contract work, the personnel corps of the Centre for Statistics, formerly known as the ISR, was drastically reduced over the years after 1990. The consequence of this reduction in the number of statisticians was that the Centre for Statistics was later incorporated into the IT section of the HSRC. One statistician remained employed. Dr Stephen du Toit, who took up an appointment at the ISR from January 1981, was responsible for quantitative data analysis and Prof. Stoker for (complex) sampling and qualitative data analysis. After Rolf Stumpf's appointment as statistician and Stoker's promotion to Vice-President, Stumpf took over the responsibility for qualitative data analysis, while Stoker, in addition to his responsibility as Vice-President, kept the responsibility for sampling. Crowther, after his appointment as Director, also took a special interest in qualitative data analysis. Since 1980, prominent statisticians have rendered extremely valuable statistical services to the HSRC on a part-time basis. Two of these statisticians are Profs H.S. Steyn and M.W. Browne. The investigations and research work done at the ISR have led to numerous MSc theses and one PhD, the latter being the study undertaken by Rolf Stumpf under the supervision of H.S. Steyn. The emphasis of the ISR's task fell in the first place on the development and promotion of sound scientific procedures for the analysis of survey data in the social and other human sciences. This objective required an in-depth study of the literature, the testing of procedures developed for the analysis of survey data, and the presentation of courses to make known and to promote the usage of these procedures by researchers in the human sciences. To meet the latter objective, courses were presented and workshops held at various places in South Africa. Furthermore, personnel of the ISR participated in or led various national investigations and projects undertaken by or contracted out to the HSRC. Examples of these are: (1) The development of indicators to measure quality of life, (2) The Joint Matriculation Board's Investigation into Differential Entrance Requirements for Tertiary Educational Institutions, (3) Various Health and Demographic surveys, (4) Various Household Income and Expenditure surveys, (5) "Sample (Population) Censuses" (i.e. a population census based on a sample) with the view to estimate populations and other demographic variables as well as household facilities. The most important of these was the ISR's involvement in the 1991 population census with the task of estimating census type variables in 88 areas across South Africa.

The above short historical overview of the ISR of the HSRC illustrates a 'rise and fall' of a strongly developed statistical institute over a period of a little more than 10 years. It had a significant impact on the use of sound statistical procedures in the social sciences in South Africa, which is still evident today.

Industry collaborations

Sasol had a long-term relationship with SASA. The Industrial Statistics and Data Science Team in Sasol was built over a period of about 20 years, and has initiated and implemented projects in Sasol processes with significant impact and value-add. Most notably was the development and implementation of the MSPEM™ Technology Package, which is an in-house developed web-based business solution that integrates near-real-time process data and statistical process modelling to deliver process intelligence and insight. The MSPEM™ package has been implemented in various Sasol processes and is used daily for decision-making, especially on the coal value chain for tracking coal properties from the source, for optimisation and management of coal blending, preparation and handling, up to the performance modelling and diagnostic analysis of the gas production facilities. Another significant project was the development of an artificial intelligent control algorithm in 2019, which has been implemented directly in the CO control program for automated control of the coal gasifiers in South Africa.

The Sasol Team has collaborated with many SASA Members and academic researchers over the years, including Prof. Linda Haines (University of Cape Town), Prof. Daan de Waal (University of the Free State), Prof. Niel le Roux (Stellenbosch University), Prof. Sugnet Lubbe (Stellenbosch University), and Prof. Paul Fatti (University of the Witwatersrand). From these collaborations, several research articles were published in national and international scientific journals. The Sasol Team also attended the SASA conferences regularly and invited international experts to South Africa, including Prof. Douglas Montgomery in 2000, Prof. Dennis Lin in 2009, and Dr Bradley Jones from SAS JMP in 2013.

There was the long-term project for Eskom that Prof. de Waal led (approximately 2002–2012). At that time, the Eskom Laboratory was established in the Department of Mathematical Statistics at the University of the Free State. In 2013–2015, the reliability project for Eskom was accomplished (led by Prof. Finkelstein) and the results (including the necessity of timely, mathematically justified maintenance of the generating units) were delivered to Eskom leadership (the latter, obviously, was not done as recommended).

In addition SAS, an international statistical software company, has been a long-term partner of SASA,and has been involved in conference funding, student funding and student development.

Maths4Stats programme

Mathematical thinking is very different from statistical thinking. Traditionally, learners have 12 years of training at school to become mathematically proficient, but only a fraction of time is spent on being statistically proficient. SASA Education Committee Members have accordingly been actively involved in advocacy and training programmes aimed at encouraging basic statistical knowledge and skills at school level.

The first such teacher training programme was the Maths4Stats programme defined by Stats SA in 2004. The SASA Education Committee was at the forefront of activities for this programme, with Delia North (SASA Education Committee) as Master trainer for the Maths4Stats programme, along with Jackie Scheiber (RADMASTE, Wits). Pali Lehohla asked North and Scheiber to partner with Stats SA to run the Maths4Stats programme, in which teachers and subject advisors were taken to venues for a few days to undergo training in statistics and probability. This programme ran for about 4 years; after the programme started to dwindle, North decided to run an extended Maths4Stats programme over weekends, at the University of KwaZulu-Natal (UKZN). An extensive annual programme followed, which was run over a few consecutive weekends, with teachers from the UKZN catchment area attending. SAS was also involved through Murray de Villiers, who came to speak to teachers, to motivate them about the value of teaching statistics meaningfully in the classroom. This programme won an ISI Statistics Literacy Award at the World Statistics Congress in Hong Kong in 2013.

In 2012, the Western Cape provincial Maths4Stats coordinator contacted the University of the Western Cape (UWC) to become involved in the Maths4Stats project. The three stakeholders – UWC's Statistics staff, Stats SA and the Western Cape Education Department – worked together to plan the training sessions. Training concluded at the end of 2014. Prior knowledge scores showed that the educators needed training in all the topics presented. Overall, the educators' knowledge improved during the training sessions.

The success of the Maths4Stats programme led to the launch of the Teachers4DataAnalytics programme, at UKZN, on 13 August 2022. This project was conceptualised by North, as a key project to create awareness amongst high school learners of job opportunities for those who study statistics at tertiary level. Nombuso Zondo (UKZN, South African Statistical Association Education Committee), was instrumental in defining the computer lab sessions (SAS Data Fly software) for the training sessions.

In order to ensure that teachers have top-class training, the Teachers4DataAnalytics programme was launched by partnering with Prof. Christine Franklin (Senior Lecturer Emerita in Statistics, University Georgia; K-12 Statistical Ambassador, American Statistical Association). The programme was extremely successful and was featured in the *Brainstorm Magazine*.

A series of three Teachers4DataAnalytics workshops were further held in 2023, at institutions around the country, led by the SASA Education Committee team of North and Zondo.

Statistics Departments in South Africa

There are Statistics Departments at all the universities in South Africa, some with significant history and others that are part of changes in university structures and that are still growing. The current departments and their heads are presented in Table 1.

An extraction of the origins of the departments as at 2003 is presented below, taken from the unpublished conference booklet.[3] The old university names are presented for historical records. Updates on institutional mergers are also included.[8] Table 1 shows the current university departments after mergers and renaming.

University of Pretoria: Probably the first recorded activities to establish a Department of Statistics at any South African university took place at a Commerce Faculty board meeting of the University of Pretoria on 3 June 1920. This was when Prof. A.E. du Toit enquired about the position of statistics and actuarial science in courses of the Faculty. Although a statistics department at the University of Pretoria was only established at the beginning of 1939, statistics was taught as part of the Mathematics syllabus since 1925 by the young Dr B. de Loor. He became the first Professor and Head of the 'Departement Statistiek en Handelswiskunde' in 1939. In 1958, the name of the department was changed to the Department of Statistics, in 1975 to Statistics and Computer Science, and in 1977 again to the Department of Statistics. After his death in 1962, Prof. de Loor was succeeded as Head of the Department by Prof. D.J. Stoker, who in turn was succeeded by Prof. H.S. Schoeman in 1981. Prof. N.A.S. Crowther has been Head of the Department since 1991. In 2004, the University of Pretoria and the Vista University–Mamelodi campus merged to form the University of Pretoria.

Stellenbosch University: The teaching of statistics has a long history at Stellenbosch University. A course in Statistics was taught to Agriculture students at the University as long ago as the 1920s, and, in 1933, a course in Elementary Statistics and Interest Calculation was initiated. This became a compulsory course for Business students in 1936. In 1942, the subject Statistical Mathematics was introduced as a possible major for Business students. A Department of Statistics was officially established in the Commerce Faculty at the University in 1946 with the appointment of Dr S.J. (Faantjie) Pretorius as the first Professor of Statistics.

University of the Free State: At the beginning of 1954, the senate of the University of the Orange Free State was informed of a request by the

Table 1: Statistics departments in South Africa and their heads, 2024

Department	Head of Department	Link to website
Nelson Mandela University	Chantelle Clohessy	website Some recent history of the department: Nelson Mandela University
North-West University: Mahikeng Campus Potchefstroom Campus Vanderbijlpark Campus	Kolentino Mpeta Gerrit Gobler Jacques de Klerk	website
Rhodes University	Jeremy Baxter	website
Sefako Makgatho Health Sciences University	Sollie Seeletse	website
Stellenbosch University	Justin Harvey	website
University of Cape Town	Freedom Gumedze	website
University of Fort Hare	Ruffin Mutambayi	website
University of Johannesburg	Jacques van Appel	website
University of KwaZulu-Natal	Retius Chifurira	website
University of Limpopo	Daniel Maposa	website
University of Pretoria	Samuel Manda	website
University of South Africa	Basetsana Pauline Ntsime	website
University of the Free State	Frans Koning	website
University of the Western Cape	Humphrey Brydon	website
University of the Witwatersrand	Stephen Jurisich	website
University of Venda	Simiso Moyo	website
University of Zululand	Maba Matadi	website
Sol Plaatje University	Dimpho Mothibi	website
Central University of Technology	Michelle Erasmus	website
Tshwane University of Technology	Seithuti Moshokoa	website
Durban University of Technology	Anisha Ananth	website
Cape Peninsula University of Technology	Thomas Farrar	website

Faculty of Commerce and Administration that there was a need for courses in statistics. This matter was discussed with the Head of the Department of Mathematics (the late Prof. A.P. Malan). At the end of August the same year, the Senate proposed to the Council that a 3-year course in Statistics should be instituted. In the beginning of 1955, a recommendation was put forward that Statistics should be offered as a 3-year major in conjunction with subjects such as Psychology, as well as subjects from the biological sciences. On 27 September 1955, the Senate announced that the Honorable Minister of Education had approved the formation of a Department of Statistics with a Senior Lecturer as head. Mr Andries Reitsma (later professor) was appointed as first Head of the Department. The University of the Orange Free State merged with the University of the North–Qwa-Qwa campus in 2003 and the Vista University–Vista campus in 2004 to form the University of the Free State.

Potchefstroom University: The Department of Statistics at Potchefstroom University was founded in 1956 when the Council of the University decided at a meeting held on 16 November 1955, that senate representation would be granted to this department. Dr J.M. de Wet was appointed as Head of the Department. The campuses of the Potchefstroom University of Christian Education, University of the North West, and Sebokeng campus of Vista University merged in 2004 to form the North-West University.

University of the Witwatersrand: The Department of Statistics at the University of the Witwatersrand was founded in 1957, with Prof. John Kerrich as its first Head. Kerrich had achieved a measure of fame for his coin spinning and urn experiments conducted while interned in Denmark during World War II, which he recorded in his monograph entitled *An Experimental Introduction to the Theory of Probability*. While still a member of the Department of Mathematics, Kerrich attended a meeting at the University on 28 October 1953, together with 12 other statisticians, at which the South African Statistical Association was founded. Kerrich subsequently spent three terms as President of the Association and was a Member of the Executive continuously until 1969. Two persons who were subsequently to make their mark internationally, Herbert Sichel and Danie Krige, both completed their master's degrees under his supervision. In 2005, the campuses of the Johannesburg College of Education and the University of the Witwatersrand merged to form the University of the Witwatersrand.

University of South Africa: The first statistician appointed at Unisa was Mr (later Dr) D.F.I. van Heerden. He was one of three academics in the Department of Mathematics in 1957. At that stage, BSc and BCom students could take Mathematical Statistics and Statistics as one of their majors. In 1959, the Department of Mathematical Statistics was formed and chaired by Prof. H.S. Steyn. Dr H.T. Gonin and Mr D.F.I. van Heerden were Senior Lecturers. The Technikon South Africa and Vista University Distance Education campus were incorporated into the University of South Africa in 2004.

University of Cape Town: The Department of Statistical Sciences at the University of Cape Town was established in 1965 as the Department of Mathematical Statistics, and assumed its current name at the beginning of 1991. The founding staff member was Prof. Cas Troskie who was later joined by his assistants June Juritz, and Arthur Money (Henley Management College) as Lecturers.

University of the North: The Department of Mathematical Statistics was established in the late 1960s (1965). It offered a major in Mathematical Statistics for students doing a BSc degree and a service course in Statistical Methods for students doing BCom or other degrees. Prof. Oliver pioneered the department as the Head and was later joined by some of his students, Mike Phala and Stanley Tlakula (Prof. Phala has now passed away and Mr Tlakula moved to the then Vista University). The University of the North merged with the Medical University of South Africa to form the University of Limpopo.

University of Port Elizabeth: The University of Port Elizabeth was established in 1964. The first lectures held on campus were on 1 March 1965, when the University opened its doors to 326 students, including 50 postgraduate students. The academic staff of 18 Professors, 8 Senior Lecturers and 7 Lecturers seems miniscule compared to the 202 academics now on campus. The Mathematical Statistics programme was started in 1965 under the tutelage of Prof. G.J.J. van Zyl. The University of Port Elizabeth merged in 2005 with the Port Elizabeth Technikon and Vista University's Port Elizabeth campus to form the now Nelson Mandela University.

Rand Afrikaans University: The Department of Statistics was founded, as was the University itself, in 1967 with the appointment of Profs A.J.B. Wiid and H.H. Lemmer and, a year later, the (then) Dr G.P. Viljoen and Mr M.J. Venter. All the founding members, except Prof. M.J. Venter, are now retired. The Rand Afrikaans University, Technikon Witwatersrand and the Soweto and East Rand campuses of Vista University merged in 2005 to become the University of Johannesburg.

Rhodes University: The Department of Mathematical Statistics was established in 1973 under the headship of Prof. P. van der Watt. The Department was formerly part of Rhodes Department of Applied Mathematics and Statistics. At the time of its establishment, the Department offered three undergraduate courses – namely Statistics, Mathematical Statistics 2 and Mathematical Statistics 3 – and postgraduate courses for honours and masterss students.

University of Natal-Durban: After a number of years in which second- and third-year, and postgraduate, courses in statistics were offered under the umbrella of the Department of Mathematics, a separate Department of Statistics was established in the early 1970s with Heinz Linhart as Professor and Head. On Linhart's relocation to Göttingen in 1975, Leon Troskie was appointed to the headship, a position he occupied for more than 20 years. With the re-organisation of the university in the late 1990s, the Department of Statistics was once again joined with Mathematics. In 2004, the universities of Durban-Westville and Natal merged to form the University of KwaZulu-Natal, and the Statistics Department of the former was combined with the Durban and Pietermaritzburg Statistics Departments of the latter.

University of Natal-Pietermaritzburg: Statistics and Biometry was founded by Prof. Arthur Asquith Rayner in 1949. Prof. Rayner, a New Zealander, arrived in Pietermaritzburg and took up the newly created post of Professor of Biometry in the Faculty of Agriculture and the Agricultural Technical Services. The first ever Biometry major for the BSc Agric degree in South Africa, and probably in the world, was thus offered at the Pietermaritzburg campus of the University of Natal. Statistics at this time was taught by the Mathematics Department. In 1974, Prof. Rayner took over the teaching of Statistics from the Mathematics Department and so was born the Statistics and Biometry Department, dually affiliated to the Faculties of Science and Agriculture. Prof. G.P.Y. Clarke took over from Prof. Rayner as the Head of the Department from 1984 until December 1998. Prof. Clarke retired and left in June 2000 to take up a research post at Agriculture West Australia in Perth.

University of Durban-Westville: The Department of Statistics was established in 1961 in the Commerce Faculty and has since offered service courses in Statistics to the Commerce Faculty. The Department began offering a BSc degree with a major in Statistics in 1972.

University of the Western Cape: The University of the Western Cape was established in 1960 for coloured students as an extension of the former government's policy of apartheid. It opened its doors at a formerly white pre-primary school in Bellville-South. It was an institution shunned and scorned by black academics, and attended under protest by most of its students, because their only other option was to forego the opportunity of residential tertiary education. There was widespread rejection of the establishment of the University College by the community. Senior academic appointments were made by political structures hostile to the community for which the university was intended. Statistics was initially offered within the Mathematics Department, but in the late 1970s, the Statistics Department was established.

University of Fort Hare: Prof. Steyn Linde, who was Head of the Department of Applied Mathematics at the University of Fort Hare, introduced Statistics into the Department of Applied Mathematics in 1962, thus forming the Department of Applied Mathematics and

Statistics. In 1978, these two disciplines were separated and the Department of Statistics came into its own right. Prof. Abrie van der Merwe and Prof. Piet Groenewald were among the early members of the Department of Applied Mathematics and Statistics and Prof. Gert Viljoen was the first Head of the Department of Statistics. He retained this position until 1996 when Prof. Joanne Tyler took over as Head of the Department. In 2003, the University of Fort Hare incorporated the Rhodes University East London campus into its structure.

University of Transkei: The Department of Statistics at the University of Transkei was established in 1982 with only two teaching staff at Lecturer level. A third Lecturer joined a year later while the first Professor and substantive Head took up his post in 1985. In 2005, the University of Transkei merged with the Border Technikon and the Eastern Cape Technikon to form the Walter Sisulu University.

University of Zululand: Statistics was first taught by the Mathematics Department as a service course to commerce students. Gradually, more and more Statistics courses for science students were introduced by the Mathematics Department. As a result of this growth in courses, a Department of Mathematical Statistics was started in 1982 under the leadership of Mr P. Steyn. After Steyn left the university, the teaching of statistics was again taken over by the Mathematics Department. In 1989, Mr Dube (later Prof. Dube) was appointed in the Mathematical Statistics Department. He was promoted to Professor in 1996.

Vista University: Vista University came into being in 1982 as a multicampus university. Initially, only basic degrees were offered, e.g. Arts, Education, Management and Law. Mathematics was offered as part of Arts from 1983. The Department of Mathematics offered Statistics at the first level. The Faculty of Science came into being in 1990, with a separate Department of Statistics. Prof. H.F.P Rautenbach (Hennie) was appointed as head of the department. Prof. Deon van Zyl from the University of Port Elizabeth developed the study material used. In the early 2000s, the various campuses of Vista University merged or were incorporated into geographically similar institutions following the restructuring of the South African education system during the period 2001 to 2007.

MEDUNSA: The Medical University of Southern Africa opened its doors to students in 1976. Since its inception, it has produced over 5000 health professionals in the fields of Medicine, Dentistry, Veterinary Medicine and Natural Science. In its short history, it has graduated more medical doctors than all other medical schools in South Africa combined. MEDUNSA has been and continues to be of major strategic importance to South Africa in redressing the race-based inequalities in healthcare provision. MEDUNSA is an institution with unparalleled success. It is located at Ga-Rankuwa, 30 km northwest of Pretoria. Although MEDUNSA was originally conceived as a health science university, an awareness of the need for science teachers in the black community soon arose. These realities led to the establishment of the Faculty of Sciences, which admitted its first students in 1989. Initially, the Department of Mathematics was housed in the Department of Physics under the leadership of Prof. Zingu. The department became autonomous as a separate unit, called the Department of Mathematics and Statistics, in 1992, and Prof. H.S. Schoeman, who was then employed at MEDUNSA as the University Statistician, was appointed as Head of Department, a post which he held until his retirement at the end of 1999. During 2000, Dr P. Gopalraj was appointed as acting Head of Department. In January 2001. Prof. John Fresen was appointed as Head of Department.

Technikon Pretoria: Statistics as a subject was first formally introduced at the Technikon Pretoria in 1980 when the School of Mathematical Sciences was created. Today, this institution is known as the Tshwane University of Technology after the merger in 2004 between Technikon Northern Gauteng, Technikon North-West, and Technikon Pretoria.

Technikon Witwatersrand: The Department of Statistics came into being in the late 1980s when it officially became a separate academic department with its own head, identity and dedicated staff. Before this date, it was incorporated within the Department of Mathematics, Statistics and Physics. In 2005, the Technikon merged with Rand Afrikaans University and the Soweto and East Rand campuses of Vista University, forming the University of Johannesburg.

It is worth also noting that universities of technology in South Africa have an important role to play and provide an alternative path to a career as a statistician. Cape Peninsula University of Technology (CPUT) is blazing a pathway to statistics careers via the diploma route for students who did not achieve a bachelor pass in secondary school. CPUT introduced a 3-year National Diploma: Mathematical Technology in 2009, which was replaced by the HEQSF-aligned Diploma in Mathematical Sciences (NQF level 6) in 2017. Admission requirements are 50% (achievement level 4) in Mathematics, English, and one of Physical Sciences, Geography, Accounting, Business Studies, or Economics in the National Senior Certificate or an equivalent NQF level 4 qualification. The Diploma includes a 6-month Work Integrated Learning placement or project completed with a partner organisation in business, industry, or government. A one-year Advanced Diploma in Mathematical Sciences (NQF level 7) was introduced in 2020, with a 2-year part-time offering launched in 2023. A Postgraduate Diploma in Mathematical Sciences (NQF level 8) is currently awaiting CHE accreditation. All three of these qualifications have Mathematics and Statistics as major subjects, with a strong emphasis on programming and computing, and domain application electives such as Biomathematics, Biostatistics, Financial Mathematics, and Econometrics. Once the Postgraduate Diploma is approved for implementation, the university plans to develop master's degrees in Applied Mathematics and Statistics. In this way, CPUT seeks to broaden access to careers and postgraduate studies in statistics to a predominantly black segment of the South African population who may previously not have had the opportunity to pursue statistics at the tertiary level. Besides offering Mathematical Sciences qualifications, CPUT's Department of Mathematics and Physics, which houses most of the university's statisticians, services statistics subjects to three faculties (Applied Sciences, Engineering and the Built Environment, and Health and Wellness Sciences).

Prominent statisticians in South Africa

Danie Krige and geostatistics

In the late 1940s and early 1950s, the mining engineers, Danie Krige, F.W.J. Ross and H.J. de Wijs, and the statistician, Herbert Sichel, developed some quantitative and highly innovative approaches to problems relating to gold-bearing ores in the mining industry in Johannesburg, South Africa. Their studies, in particular that of Krige on prediction across a spatial field and that of Sichel on long-tailed distributions, have had a great impact on statistical methodology over the years and are outlined here. Danie Krige completed a master's thesis at the University of the Witwatersrand in 1951. He introduced the concept that ore grades are a spatial variable with a spatial structure and used weighted regression techniques to estimate ore reserves.[9-11] Georges Matheron, a French mathematician and engineer at the French Geological Survey in Algeria, identified the work of Krige and developed a more formal approach. Matheron published a series of papers, initially in French and later in English, and, in a paper in 1967, named the approach kriging in honour of Krige.[12,13] A timeline detailing the birth of the geostatistical model in Africa is given in Haines and Thiart[14] and the findings are indeed truly 'Out of Africa'.

In essence, the work of Krige and Matheron relates to the sampling of ores over a spatial field and, more specifically, to the construction of an optimal predictor at an unobserved location on the basis of observations already taken. Their approach was distribution-free and is predicated on the fact that observations located close together are likely to be more highly correlated than those located further apart. Methodology based on the kriging model has advanced in a way that can only be described as amazing. Specifically, the assumption that the observations in the kriging model are distributed as Gaussian, considered by the geostatisticians to be a 'leap of faith', has led, in turn, to the concept of the model as a stochastic process, termed a Gaussian process. This notion has evolved further within the machine learning arena and Gaussian processes are widely used today as surrogates for complex models with multiple inputs and outputs.

Herbert Sichel made great advances in the study of long-tailed distributions in the early 1950s. Specifically, it was well known in the

mining industry that histograms of large numbers of assayed ore grades were notoriously long tailed. Sichel introduced the log-normal distribution to provide a fit to the histograms and thereby to facilitate a meaningful statistically based summary of the data and, in addition, developed the Sichel t-estimator. Somewhat later, Sichel developed a novel long-tailed distribution, which is rooted in those of the inverse Gaussian and the Poisson, and which was named the Sichel distribution.[15,16] The log-normal distribution is widely used in applied statistics in areas ranging from health care to finance and still presents some interesting theoretical challenges in the modelling of spatial data. In addition, the Sichel distribution itself is well known, particularly in the field of linguistics, as a model for word count data.

The use of geostatistics, in particular kriging, continues to flourish within the South African mining community. In addition, research into the methodology underpinning spatial statistics more generally and into a vast range of applications is, and indeed has been, actively pursued within the South African universities.

Trevor Hastie and statistical learning

Prof. Hastie worked at the Institute for Biostatistics at the Medical Research Council in the Western Cape for 3 years from 1977 to 1980; he had a BSc and worked in applied statistics. During his stay there he made some plots for Prof. Cyril Wyndham, for an article he was preparing. They had discretised some quantitative variables in a logistic regression, creating a number of bins for each. He then plotted the resulting fits as a piecewise constant function for each variable. He has no record of these plots, but in his mind these were the seed for what was to become 'Generalized Additive Models', his first book with Rob Tibshirani in 1990.

In 2003, he was invited as a special guest to attend the SASA conference in Johannesburg. It was the occasion of the 50th anniversary of SASA. The other special guest was Sir David Cox (full disclosure – he labels himself invited as the special "expat" guest). Nevertheless, this was one of the highlights of his career. He enjoyed being with David Cox, and was impressed with how he paid attention to the younger people.

Hastie has co-authored seven books. The last five of these are freely available as PDFs on his website, with permission from the publishers. They have also filmed a 10-week course based on the two 'Introduction to Statistical Learning' series (the first with R labs, the new one with Python labs). These courses are available for free via EdX, and he is happy to know that these and the free books have been used in South African classrooms.

Hastie worked at AT&T Bell laboratories for 8 years, and was part of the team that developed the statistical modelling software they use in R. He has been a Professor of Statistics at Stanford University for 30 years, and has spent all his sabbaticals in South Africa.

Random matrix theory

Random matrix theory is a rich, and often complex, branch within statistics that has fundamental roots in South Africa. Essential elements of interest that stem from this statistical area include hypothesis testing when considering equality of multiple means, sphericity of covariance structures, likelihood ratio testing in the linear model scenario, and classification in a discriminant analysis context, for example. There are several South African academics who made significant contributions during the latter half of the 20th century in these fields, and its impact is still observed through (1) regular citation in the current era and (2) its relevance and implementation in multidisciplinary fields. The works of Daan de Waal[17-21], Willie Conradie[22], Cas Troskie[23,24], June Juritz[25], and Kotie Roux and Andriette Bekker[26-28] are particular examples that stand out in this case. Recent citations[29] of these works are present.

In wireless communications, the distributional characterisation of wireless signals between transmitters and receivers is mostly assumed to be complex Gaussian; the quadratic form of this characterisation is of sincere interest when analysing a large multiple-input-multiple-output (MIMIO) system's capacity (loosely 'bandwidth') or probability of a signal failing (via a signal-to-noise ratio). These types of analyses are rarely theoretically complete without a theoretical investigation and determination of the accompanying (maximum, minimum, or joint) eigenvalue behaviour of such quadratic forms. In a mathematical sense, the complexity of tractable and implementable derivations and solutions are exacerbated by these considerations, predominantly in the complex realm.

In this context, the essential contribution within this branch of multivariate analyses was particularly influenced by South African stalwarts of statistics, especially some of the work by Cas Troskie as well as the collaborators and legacy that he played a major role in securing for South African statistics. An example by Troskie[30] was instrumental to the development and refinement of the theory of MIMO systems, and continues to be cited within this field in this century.[31-35]

Through the contributions of individuals such as these, the random matrix theory subdiscipline in statistics is richer, stronger, and more flavourful than otherwise.

Multivariate statistics in South Africa

Among the first generation of statisticians in South Africa, Fanie Steyn was the specialist in multivariate statistics. Several of his PhD students – Cas Troskie, Kotie Roux and Michael Browne – followed in his footsteps. Amongst others, Daan de Waal, Willie Conradie, Riaan de Jongh, June Juritz and Les Underhill all obtained their PhDs under the supervision of Cas Troskie. Although Kotie Roux (and similarly Daan de Waal) later moved to Bayesian statistics, he supervised Niël le Roux, Piet Becker, Andriette Bekker, Paul Mostert and the master's of Michael Greenacre. In the meantime, Hennie Venter obtained his PhD in Chicago under Raghu Raj Bahadur, and, on his return, supervised Tertius de Wet who supervised Freek Lombard. Doug Hawkins, supervised by SASA co-founder John Kerrich, was Wits's first PhD graduate and in turn supervised Paul Fatti. Multivariate statistics was an active research field in the 1970s and 1980s at Unisa (Fanie Steyn Sr, Kotie Roux, Michael Browne, Michael Greenacre, Freek Lombard, Dan Bradu), the University of Cape Town (Cas Troskie, June Juritz, Les Underhill), University of the Free State (Daan de Waal, Piet Groenewald, Abrie van der Merwe), University of Pretoria (Piet Becker, Andriette Bekker, Nico Crowther), Wits (Doug Hawkins, Paul Fatti, Jacky Galpin), the then Potchefstroom University (Hennie Venter), Rhodes (Sarah Radloff), UKZN (Arthur Rayner), University of Port Elizabeth (Nico Crowther, Nico Laubscher) and Stellenbosch University (Niël le Roux, Willie Conradie). Nico Laubscher supervised Martin Kidd while Niel le Roux supervised Willie Conradie's master's and the PhDs of Sarel Steel, Nelmarie Louw, Sugnet Lubbe, Ruan Rossouw and Mwanabute Ngoy (Zambia). In turn, Niel le Roux and Sugnet Lubbe supervised Johane Nienkemper-Swanepoel while Sugnet also supervised Raeesa Ganey and co-supervised Andre Mostert with Roelof Coetzer. The Stellenbosch research group formed the Centre for Multi-Dimensional Data Visualisation (MuViSU) in 2021 with 5th and 6th generation students being supervised by Sugnet Lubbe and Johane Nienkemper-Swanepoel under the watchful emeritus eyes of Niel le Roux.

In the early days, the focus was on multivariate distribution theory and the development of Fortran routines for computations such as zonal polynomials. Later Michael Greenacre's 1984 monograph[36,37] introduced correspondence analysis to the English-speaking world. From Dan Bradu's collaboration with Ruben Gabriel on biplots to the present day, MuViSU is still actively developing methodology and software in the realm of biplots and multidimensional visualisation.

Statisticians in the SAJS

A number of researchers in the statistics community have contributed to the *South African Journal of Science* over the years, namely in financial statistics[1,38,39], in segmentation techniques[40], and on the important aspect of transformation at South African universities[41] with Dunne[42,43] providing important mathematical discussions regarding this analysis. Stewart[54] also tackles the mathematics and statistics used to rank universities, a hotly debated topic in academia, and the drop-out rate at universities in South Africa is also examined[44]. De Jongh[45] highlights the importance of industry training in Statistics degrees; Chikobvu et al.[46] contribute to rainfall understanding using statistical extreme value theory; and trends in road accidents in South Africa[47] are examined, as well as issues in public

health[48]. Van Staden report on the gender gap in science[49] and John et al.[50] provide an analysis of gender in science across Africa. Pazi et al.[51] look into electricity fraud in South Africa and Verster et al. investigate home loan offers using tree-based ensemble methods[52]. More recently, deep learning has been investigated for solar energy.[53]

Future of statistics in South Africa

Academic statistics in South Africa was declared in crisis by the National Research Foundation in 2015, due to ageing professors and limited mentoring staff at middle level positions. Ring-fenced funding was made available to assist the field with growth of new young academics. This grant was instrumental in supporting postgraduates and young staff without PhDs. The field is still operating at a less-than-optimal staff capacity, with all departments in South Africa experiencing huge teaching loads, resulting in staggered research output; however, through additional funding, there is still a focus on supporting academic statistics. Funding instruments, through COE-MaSS and NGA-MaSS, have been important in the statistics community, albeit focused more broadly on mathematical sciences but inclusive of statistics. Without these funders, the community would not have advanced to including many younger staff members who are passionate about statistics.

In 2020, an interest group of young researchers was initiated by Prof. Inger Fabris-Rotelli (University of Pretoria) to start discussing the challenges of doctoral supervision for novice and early-career supervisors in the absence of senior mentors, as well as possible solutions to these challenges. This group, composed of seven members spread across South Africa, has been meeting virtually since mid-2020 and has been identifying, discussing and documenting a number of issues pertinent within their own institutions – issues both common and unique. This group's meetings have shown that there is an urgent need for more support for young academics in statistical sciences in South Africa. This Statistics Supervision Network in South Africa (StatSNetSA) expands on the original group to include additional early- and mid-career academics across South Africa. One of the purposes of this network is to provide one other with support and guidance on how to effectively supervise statistics doctoral students. The group is now a special interest group of SASA and is active in providing support to the statistics community in development across institutions and experience levels to learn from each other in the absence of enough senior professors in the community.

In 2023, the South African Mathematics Society (SAMS) and SASA, under the leadership of the respective presidents and Prof. Loyiso Nongxa, initiated discussions towards a National Strategy for the Mathematical Sciences. The aim of these discussions was to actively pursue a path to improving the pipeline of mathematical sciences from pre-school into tertiary education and industry. The Mathematical Sciences Strategic Alliance has since been initiated to tackle this important pipeline.

SASA holds its annual conference every November, at which 250–350 statisticians from around the country meet every year. The conference serves as an important networking event to share ideas and further the field of statistics.

Due to the current data science buzz in all facets of society, the statistics community has an important role to play in grounding the field with statistics literacy and expert understanding, for example in explainable artificial intelligence (XAI). The skills of a statistician are essential to the underpinnings of data science and machine learning. The community in South Africa is passionate, energetic and willing to work together to advocate for statistics as a non-negotiable field of science. SASA will continue to support the field and its players, in its traditional form as well as in the advancements that are demanded by a speeding technological society.

Declarations

I.F.R. is the current (2023–2024) President of the South African Statistical Association. Other authors are Members of the Association. There are no other competing interests to declare. There is no AI or LLM use to declare. All authors read and approved the final version.

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Access and trust in scholarly communication and scholarly publishing

"It is obvious," this excellent collection begins, that scholarly communication and scholarly publishing are changing, that digital technology is having a huge impact on how we produce, share and consume knowledge, and that current systems are far from ideal. What is less obvious is the complexity of this system, the consequences of its rapid growth, and how to make sense of the multiple role-players and dynamics affecting the context. The value of this book lies in its insistence on complexity and nuance, to a large extent based on an analytical heuristic that manages to be both comprehensive and rooted in real contexts at the same time.

The analytical framework that the editors of the book propose consists of four key components: the increasing digitisation of scholarly communications and publishing; the growing importance of profits and economic rationales for publishing; the use of metrics and other quantifiable indicators to measure publication outputs and their impact; and the "medialization" of research, or the importance of the public understanding of science within a context in which science has lost public trust. This framework is very useful for considering how publishing has changed, but also how universities, academic libraries, scholars, and the nature and objectives of research itself have changed. Its key strength, I would argue, is that it brings into conversation several debates that usually happen separately, considers how they interact, and foregrounds questions such as infrastructure, which tend to be seen as subsidiary. The well-rehearsed structural problems and crises of scholarly publication, including shrinking library budgets, the politics of access, and the erosion of trust in self-regulating mechanisms like peer review, are given a fresh spin when examined through this conceptual lens.

Issues of access and trust underlie most of the contributions to the book. Digital technologies have created possibilities for making scholarship available to a wider audience than could previously have been imagined. The contributions make a compelling case for the importance of opening up access to research data and results. At the same time, the treatment of open access is highly nuanced and built on detailed case studies and extensive data collected from interviews and policy documents. Access is situated within the results of consultative meetings on policy and open access mandates, discipline-specific and highly divergent views on the value of and ways of working with open access, and evolving models that go beyond the established green and gold routes. The hoped-for economic efficiency and other benefits of open access are interrogated, as well as the effects (both positive and unintended) on scholars' publishing behaviour. There is still a refreshing wariness of technological optimism, and of the potential risks of relying on technology companies pursuing their own agendas and profits. More than one chapter points out that the digital is not neutral; it can be affected by changes in software or hardware, business strategy, laws, political systems and ethical mores – with potentially far-reaching consequences for scholarship.

Chapters consider a wide range of role-players, including scholars, universities, funders and policymakers, academic libraries, and publishers. As a scholar of publishing studies, I am always alarmed whenever discussions on scholarly communication suggest that publishers' role in this ecosystem should be weakened (as one of the chapters in this collection does). Part of the reason that scholarly publishers tend to be criticised or even dismissed in this way is that they are regarded as support or service institutions, rather than as an integral part of the scholarly communications value chain. With its attention to questions of infrastructure and its insistence on the reality that digitisation is neither free nor cheap, this book manages to avoid some of the more simplistic views that criticise publishers' business models without proposing sustainable alternatives or considering the importance of a plurality of models. Moreover, the persistence of print and the cost of parallel publishing complicates the view that digital technology has completely overturned existing operations and procedures. Publishers' perspectives are included in several chapters, highlighting their investment in digital infrastructures for scholarly communications (including core issues of metadata, rights management and production), their part in archiving, and their differential policies on open access. Legal matters and copyright are also relevant perspectives here, covered in separate chapters in the collection, and give food for thought in the current debates on the role of generative AI and text mining. As is discussed, in the absence of over-arching international law, a single global guideline is impractical and unachievable, but pragmatic solutions are essential as we grapple with these challenges and possibilities.

The collection has some limitations, although it is a thought-provoking contribution to our understanding of scholarly publishing. While the chapters aim to be as diverse as possible, considering different disciplinary approaches and the role of different stakeholders, the focus falls more heavily on journals rather than monographs, and on publicly funded research. Inevitably, too, the collection focuses on the German and European experiences, but a special effort is made to show how the challenges and potential solutions are applicable in many contexts globally. The point is made that local conditions are still relevant, even in a global and primarily digital environment. It is clear that the current structure is a hierarchy, in which the larger publishers, well-funded institutions and established researchers gain the most from digitisation and open access. This analysis could be extended in the South African domain by including our particular situation in the Global South, taking into account the uneven power dynamics in output, visibility and finances in scholarly communications. The funding situation for science and technology is vastly different in the South African context. In addition, in a smaller context, the role of publishers should be reconsidered – as important stakeholders in producing and disseminating locally relevant research and publications.

An English translation of the work, originally published in German, is thus a relevant and useful contribution to debates on scholarly publishing, in South Africa as well as elsewhere.


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