

PHOENICS Newsletter

Brian Spalding at 100



CHAM

Dear Reader

January 09 2023 would have been Brian Spalding's 100th Birthday. It is marked herein with memories from some of those who knew him scientifically, personally, and both.

Brian was a force of nature: scientist, academic, engineer, mentor, free thinker, father of CFD, creator of PHOENICS, poet, intellectual, family man, humanitarian, and more.

He went his own way which meant he did not necessarily fit standard parameters. He did what he thought was "the right thing to do" and not what was expected of him – this made life interesting on many occasions.

Brian was not accepted into the Royal Society until 1983; he was 60. Late? For someone of his achievements? This may have related to his refusal to "toe" any line.

He loved Russia but when he felt that personal freedoms outweighed state restrictions he worked, successfully, for the Levich family to emigrate without reducing his affection for the country, or its people, one iota. He was warned that, to succeed, he must proceed "quietly". He made as much noise as possible - and it worked.

He was scientific AND artistic. He loved physics and felt that, due to his enjoyment of all he did, he had the good fortune never to have "worked" a day in his life. He was happy writing equations at CHAM or writing poetry (or equations) on a beach. He hoped to be remembered as much for his poetry as for his science so some can be found here – including the only "Autobiography" he could be persuaded to produce, and a prescient ode to a bus.

Hopefully, the contents do justice to a man who made a major impact on life, and so many lives, for over 70 years.

There is no contents list, no particular order, poems and pictures appear where there was space – please dip in, browse, and enjoy.

Kind Regards

Colleen Spalding, Editor



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Winter
2022/
2023

Brian by Colleen



Brian was unique. He was never happier than when writing, or thinking, yet claimed never to work - a surprise to we who arrived after him at CHAM and left before him. Many here write of the scientist with more knowledge and skill than could I. I write, briefly, of husband, father, colleague, idealist, poet, activist, linguist, intellectual, polymath, Renaissance man, whose guiding precept was to do what was the “*right thing to do*”. He had a sense of humour, selective hearing, an unmatched work ethic, could be irritating, was not always easy to live with, and had a *two-sided brain* with an equal affection for, and ability in, science and the arts. I miss him.

I met “Professor Spalding” early in 1973 and joined Imperial, and CHAM, that June. There was no indication I would spend the next 50 years at CHAM, that Brian and I would marry and have two sons (William and Jeremy) and that I would fly to Moscow in October 2016 to be at the bedside of, and bring back home as promised, a man who most of us (myself included) considered immortal. I knew how ill he was – even so it was a dreadful shock when, having gotten Brian to London, he did not survive.

Brian wrote poetry and said, often, that he would like to be remembered *for* his poetry; some is contained herein. He published 4 volumes translated into Russian, and published, by Sergei Sapozhnikov of St Petersburg: **My Brass Rubbings** (2004), **Strangely Sacred** (2005), **Egyptian Twilights** (2008), **My Sail-Hoistings** (2011). Would there have been more? We will never *know* - but I think so.

Brian would *not* write his autobiography despite urgings from colleagues, friends, and myself over decades. His poetry has to stand as the way *he* chose to record his life. The day after he died, I found a poem which was read at his funeral, is in RS Fellows Memoirs, and appears later. He wrote of going gently into that dark night and a plea: do not unplug. He wrote of the 93 bus and could not be persuaded to write about the 94 – perhaps he knew.

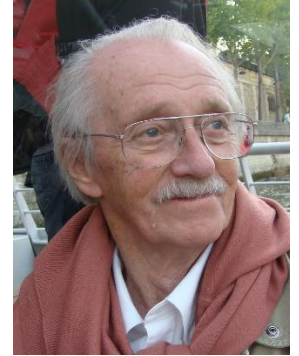
The 93 Bus

*At last I'm ninety-three:
The number of the bus
That ev'ry day I see
Nearing its terminus.*

*Which it indeed does reach,
Then promptly turns around:
North Cheam from Putney Bridge;
Once more it's journey-bound.*

*I guess, though, it would like,
Within the next ten years:
A Total Transport strike!
With passengers in tears,*

*Its windscreen too, ablu,
Lacking acceleration,
It surely will prefer
A lasting destination.*



Brian and Eda, his first wife, had 2 daughters and 2 sons. We shared 2 sons. There were 9 grandchildren and 6 great-grandchildren. Brian loved his family but was not a “natural” parent/grandparent. He was known, ultimately, by all the family as Brian rather than “Dad” or “Grandpa”. He seemed to prefer it that way.

We worked together but agreed not to talk “shop” at home. Instead, our dining room table resounded to literary or political debates (often heated) or discussions as to solutions of the Times Crossword. A return to “work” was followed by the ritual of the nightly News then back to writing – often poetry rather than science.

Brian was physically, as well as mentally, active. He rowed at KCS and Oxford. He swam on Friday nite (except when it was Book Club) until he left for his last trip to Moscow. He ran, cycled, walked. Walking was a joy. He thought as he crossed Putney Heath and Wimbledon Common to the Village, listened to sounds around him, watched changing seasons, formulated new equations, constructed poems. He is remembered by a bench in the area he loved.



We had different interests outside CHAM. His mainly scientific. Mine not. I attended his lectures. He came to my Concerts *despite* the music – he loved Beethoven, Prokofiev, Mozart, Will Todd – not Church “dirges”.

I started a Book Club. Brian was uninterested until it met at our home. I asked if he would join us as he enjoyed Makine. He came, participated, chose the next work, evinced astonishment that we actually “discussed” books. I am unsure what, if any, previous experience he had of Book Clubs but he was a valued and invaluable member of ours. He delayed his fateful Moscow trip by a day so as not to miss what was to be his last literary discussion.

I said he may not be considered a “natural” parent; that would be by today’s parental expectations rather than those of *his* day. He enjoyed his children, felt responsible for them, took pleasure in their activities and their company (especially if *they* were happy to discuss or contribute to crossword solving – he had no “small talk”). He advocated that children should be given time to be “bored” rather than constantly involved in activities as times with “nothing to do” were times when minds could expand and thoughts germinate. I think he was right.

For a man who wrote all his life he could *not* be persuaded to write of himself. He wrote books, papers, articles, on all elements of the science he loved: CFD, heat transfer, combustion, turbulence modelling but to pen the *Life of DBS*? No. After celebrating turning 90 at IC he received more requests for an autobiography. His Response? “Do they not realize I read “it” to them last night”? This is “it”:

My Three Lady Friends

*The first tells me each week: "I'm bored;
"Invent a newer game:
"Fresh goals, fresh rules bring fresh reward."
Restlessness is her name.*

*The next sweeps mental store rooms clear;
So, if by any chance
New thoughts float in, they find space there.
Her name is **Ignorance**.*

*The third, who nothing does all day,
Has brought me most success
By urging: "Find **some simpler way**."
Her name is **Laziness**.*

*That they let other men enjoy
Their charms I do not mind,
But, all the same, some care employ
So they're to **me** inclined.*

*To show I share the attitudes
Restlessness advocates,
I shun cliches and platitudes;
So now we are soul mates.*

*To **Ignorance** my gratitude
I show by letting new
Unlikely notions be reviewed;
And sometimes keep a few.*

*Dear **Laziness** I gratify
By proving **she is right**:
There **is** a simpler way. That's why
She visits me each night.*

*When DNS, then LES,
Wasted my energies,
"To discretise;" said **Laziness**;
"Gets pdf's with ease".*

*Prandtl and Karman, clever guys,
Linked **uplus** with **yplus**.
Too hard for me; so I devise
Yplus as **f(uplus)**.*

*"You want the distance from the wall?
"Use your imagination",
Says **L**; "It isn't hard at all.
'Just solve Poisson's equation*

*Which I did later useful find
For transfer (radiative)
Of heat **and noise**. A vacant mind
Can be, by chance, creative.*

*I studied finite elements
Till stopped by **Laziness**;
For FVM (it's common sense!)
Can model **any** stress.*

*These friends say none more ignorant
Nor lazy they have found;
So of their aid I'll nothing want
Till I lie underground.*

*"E'en then", wise **Restlessness** has said,
"You'll not have long to wait;
"For I can help the restless dead
"Quickly re-incarnate".*

*A genius she has, or two,
Now waiting in the womb
For me; so, to **our** precepts true,
My life I can resume,*

*If I shall promise, **as I do**,
Daily all three to bless:
Kind **Restlessness**; **Ignorance** too;
Last... lovely **Laziness**.*

Brian did not underestimate his achievements but felt they resulted from the way his mind worked and that **anyone** could do what he did - *if they tried*. I think not.

Your 100th Birthday would have been full of rejoicings, parties, lectures, and awards, Brian. You would have enjoyed them but protested – before and after - that time could have been better spent. I hope you are spending your time as you would wish.

You made life interesting. You are missed, remembered, and talked of, every day – of which you would probably – even undoubtedly - disapprove.

Brian – My Father: Jeremy

Throughout our childhood, William and I spent numerous pockets of time with Brian as he endeavoured occasionally to share moments with just us boys. The purpose could have been to show and teach us things through experiences, as parents are wont to do. Other times perhaps the aim was simply to give Colleen some much-deserved respite from the daily rigours of full-time work and raising two children, which was done for the most-part singlehandedly as Brian's (very much self-imposed!) work and travel schedule meant he was not always the most present father. Nevertheless, I believe that, while Brian was not able – nor, perhaps, willing – equally to share the duties of raising us, he did appreciate and admire Colleen's efforts, and would make attempts, perhaps too indirectly, to show as much. (I should also say that it is not outside the realm of possibility that these activities or outings with us were not-so-subtly insisted upon by the force to be reckoned with that was his second wife!) Regardless of the motive or impetus, I feel fortunate that they happened, and often reflect fondly upon these snippets of Brian time peppered throughout my life. They are framed and hung like family photos over a cliché mantelpiece. Perhaps they are somewhat rose-tinted, perhaps embellished by time and distance, perhaps some are simply misremembered. Regardless, they are my memories of a father I miss very much and plan never to forget. I thought I would share a couple of them with readers of this newsletter in the hope that it might reveal a side of a many-faceted man that some of you may not have seen during your time with Brian.

Probably my first vivid memory of William and I doing something with our father was in 1986, just before we moved into our house in Putney Heath. I remember spending a morning (which could have been an afternoon) burning leaves (I think) on the driveway of the new house. I have absolutely no idea why we were doing this, or why we were doing it there as opposed to in the garden - which is presumably where the leaves came from - or where Colleen was at the time, but Brian had collected what seemed like a mountain of leaves on the driveway and now they were on fire. I'm not sure that this would have remained quite so vividly in my recollection were it not for the traumatic event which ensued. William, presumably being just as unfamiliar with roaring furnaces as was I, and certainly being of a bolder disposition, reached out towards the fire. We had of course been instructed not to get too close to the flames, but it seems Brian had not been clear enough in his warnings. William wasn't recklessly trying to put his hand

into the fire; however, he was curiously pawing at the white cloudy bits around the edges of the leafy inferno. Before Brian was able to do anything about it, the next thing we knew William was crying in agony after trying to seize one of these soft plumes of smoke spiralling before him. What followed is a little hazy but I'm fairly sure it involved a cold water tap and a swift drive back to our old house in Wimbledon. While I'm not sure it was the plan, this actually served as our first practical introduction to two central components of Brian's beloved field of work – combustion and heat-transfer. I suppose it could be said that William's tears ticked off the fluid-flow component too! As I type this, I think perhaps this was in fact the purpose of the activity, but I am certain Brian hadn't intended it to be quite such a hands-on lesson.

Some of my oldest and fondest memories are of Brian telling me bedtime stories. These were not, however, read from books; not the classic, tried and tested stories that children have fallen asleep to for years and years, generation upon generation. No, no, Brian's stories were always entirely original, invented on the fly, with me at the centre of an, often epic, adventure. The settings could be as local as the 'Frying Pan' (a minor geographical feature of Putney Heath, a two-minute walk from our house) or as far afield as the moon – a considerably longer walk! Thankfully, Colleen insisted Brian kept a cassette recorder with him during these story-time sessions, so I still have a tape which serves as evidence not only of Brian's spontaneous creativity, but also of his seemingly infinite patience as – in my excitement at being the hero of my own adventures – I would interrupt, correct and adapt his narratives on a frustratingly regular basis. More often than not my 'editor's notes' would be to include William in whatever the evening's escapade happened to be. It is quite possible that I would have more tapes had I allowed Brian to tell the story of his imagining! It might also be said that the excitement his stories roused within me – as I rescued friends and neighbours from floods of Biblical proportions or escaped monsters on the moon - may not have been particularly conducive to sleep and may have had the exact opposite effect to the intended outcome. Perhaps a combination of these two factors eventually caused the story-telling to come to an end.

Aside from the prolonged pockets of quality time like those described above, there were many more frequent, often more mundane, activities that I remember sharing with Brian. Daily rituals like driving to school on a morning with story tapes playing, or helping to cook a pot of porridge - Brian's favourite (and only when at home) breakfast. The story tapes were of course not of my, or

my brother's, choosing, but instead were less child-friendly (albeit still quite riveting) audiobooks like *I, Claudius*, *Captain Corelli's Mandolin* and *Perfume*. The escapism enabled by these cassettes was broken only occasionally by Brian pointing out how the trees along Parkside had changed colour so magically as the seasons changed. Something I always loved about Brian was how in awe of nature he was; how, no matter how busy he was with work, he never failed to notice the leaves, or hear the birds, or smell the fresh air. (Just as an aside, it was as a result of these comments about leaf colouring that it dawned on me that the world probably wasn't actually black and white during Brian's childhood, despite all the photographic evidence to the contrary!)

The porridge breakfasts were basic but enjoyable; heated with water, not milk (every porridge eater I've met since finds it very odd not to cook it in milk). I enjoyed creating porridge islands with my milk. Brian didn't miss an opportunity to teach even here, as he explained that the porridge would cool quicker if I increased the surface area by spreading it to the edges of my wide-rimmed bowl. This ruined my islands but meant we could leave for school on time!

Many years later, once I returned to London after fifteen or so years living away, my relationship with Brian became closer than it had ever been. My reason for returning was to spend more time with him after seeing a photograph taken at a dinner where, in my opinion, he was not looking at all well. His health improved thankfully, and I am grateful that we were able to spend a lot of time together in his final years. The most regular shared activity was eating dinner with both my parents while doing the Times2 crossword – I was never able to crack the codes of the 'proper' Times crossword unfortunately. This was always extremely enjoyable and I was endlessly surprised by Brian's ability to pluck rarely used words from the annals of his memory. In fact, quite often, so was Brian! Colleen and I still enjoy doing the crossword together, and we now have the extremely knowledgeable addition to the team of Blandine, my fiancé, whose vocabulary is second to none, despite not being a native English speaker. Nevertheless, to this day, Brian's input is very much missed, particularly when the clues relate to science, poetry or the classics, and we find ourselves having to cheat more often than once was the case!

I loved Brian's sense of humour; it was a joy to hear him laugh and an even greater one to cause him to. When we were young, William and I used to roll our eyes when the same old jokes were rolled out for dinner guests or at parties. Yet, as an adult, I was amazed at how Brian could

still get equal enjoyment from telling the same jokes as he had for the past twenty years – if not more! The joke never lost its sheen for Brian, and fun was never far from his mind; if a situation did not warrant his telling a staple joke from his extensive library, then a conversational gap could certainly be filled with one of his many favourite riddles, or perhaps a rhyme or limerick. One of his favourite, and most regularly recited, rhymes to share at the dinner table was:

"I eat my peas with honey,
I've done it all my life.
It makes the peas taste funny
But it keeps them on the knife



Given that this was heard almost every time peas were served, whether or not there were guests present, you can imagine how old this got for us, but it never failed to amuse Brian who performed it with the same childlike enthusiasm every time. I have a feeling that our daughter and any siblings she may have will one day be rolling their eyes at me as I repeatedly recite their grandfather's favourite rhymes and riddles throughout her childhood! I only hope they too find the same appreciation for them as I did later in life.

I am discovering through writing this relatively short piece that I could continue for a great many pages, recounting a plethora of memories of times shared with Brian, or just of his idiosyncrasies, the things about his personality that could at different times infuriate and endear him to one. However, in the interest of delaying Colleen's Newsletter no further, I will wrap up now and end by sharing one of Brian's favourite riddles that I remember from my childhood, and which I think I read at his funeral:

You find yourself at an unmarked intersection. In one direction is the City of Lies, in the other is the City of Truth.

Citizens of the City of Lies always lie, citizens of the City of Truth always tell the truth.

At the intersection is a citizen of one of these two cities, but you don't know which.

What one question could you ask them to discover the way to the City of Truth?

Gone but never forgotten, Brian will always be in my heart, and I'm looking forward to sharing stories of him with my daughter, and striving at the very least to emulate his unwavering ethos of 'doing what is right' – a philosophy that was at his very core and governed his actions throughout his long and fulfilling life.

I love you Brian, thank you for simply being.

Brian Spalding: My Teacher, My Friend, My Hero: Suhas Patankar

No person has made a more profound and lasting impact on my professional and personal life than Brian Spalding. In 1964, I came to London to work as a Ph.D. student under his guidance. Soon we became good friends and that friendship lasted forever. He was a brilliant scientist and a skilful teacher. Moreover, he was very kind and generous to me and my family.

Brian's scientific work is noteworthy not only for the variety of subjects he covered but also for the strong impact of his inventions. None of his work made just an incremental contribution. It was always a significant breakthrough, opening the door to many scientific opportunities that did not exist before. His vision and creativity provided a quantum increase in our scientific understanding and predictive capability.

For me, he was a great source of inspiration. He taught me how to grasp complex problems and pursue grand ideas. I learned from him how to teach and communicate effectively. He is largely responsible for my professional success and personal joy.

I am associated with two scientific breakthroughs. Both were accomplished when I got to spend a lot of time with Brian. The first happened in 1966 when we both travelled to the USA to attend a conference. We attempted to create a finite-volume method for two-dimensional boundary layers. This work led to a very popular book and a computer program. In 1971, the Spaldings hosted my family for two months. At that time, Brian and I took the train every day from Wimbledon to South Kensington (where Imperial College was). During our train ride, we would discuss possible methods for three-dimensional flows. Often, I would propose a method and Brian would express his objections. Next day, I would describe a modified method and hear new objections. However, one day, he tentatively approved what I proposed. I quickly implemented the method and solved a substantial problem. With great excitement, I went to show him the results. I distinctly remember the joy and glow on his face. We both knew that we had achieved something big. That was the birth of the SIMPLE algorithm.

Over the years, I have enjoyed my interactions with him and his family. It has been a pleasure to host them in our house in the USA. I have marvelled at his intelligence and sharpness right up to the final moments in his life. For his teachings and friendship, I remain forever grateful to him.

Suhas V. Patankar patankar@inres.com



Brian Spalding - A Kind and Generous Man: Rajani Patankar

I am not Professor Spalding's student. I know very little about engineering. So, I cannot comment on Brian's ground-breaking contributions to heat transfer. However, I got to experience the kindness and generosity of this exceptional individual.

My husband, Suhas Patankar, worked with Brian for his Ph.D. After finishing the degree, he returned to India and soon thereafter we got married. Suhas started working at IIT, Kanpur in India. However, Brian kept urging Suhas to return to England to work with him. So, after three years, we came to London with our little daughter. Brian came to the airport to receive us and waited for three hours before we came out. To my surprise, he had made arrangements for us to stay in their home in Wimbledon. Actually, we ended up staying there for two months before we moved into our apartment.

I was new to England and to the western culture. Brian and Eda (his first wife) were very kind, supportive, and understanding. They went out of their way to make us feel comfortable in their home. Their tremendous generosity and kindness touched my heart. The experience of staying with the Spaldings has made a lasting impact on our life. We felt a mutual bond of affection with Brian and Eda.

That same closeness continued with Brian and Colleen. Over the years, we have met many times at conferences, we have visited them a few times in London, and they have come to our house in Minneapolis. Every time, we experienced their closeness and affection towards us. We feel that this has been a valuable gift to us. We will cherish that feeling for the rest of our life.

Rajani Patankar
(Wife of Suhas Patankar) patan001@umn.edu

A Tribute to an Exceptional Man D Brian Spalding: Akshai Runchal



It is rare to come across an individual who is a good researcher, a good teacher and fun to be with socially and at the pub. Brian Spalding was all that, and more. It is tough deciding what to say about him. Where do I begin?

That he was an exceptional man.

That he made exceptional contributions to science. That he was a multi-dimensional personality who had expertise in multiple branches of science and spoke multiple languages fluently. That he was a man who would risk valuable professional relationships for the sake of a principle – that of right to freedom of a scientist from a dictatorial regime.

That in spite of an age difference of 20 years, I could sit with him on a verandah in Kanpur, have a beer, admire the sunset and watch the world go by. That he would risk a drive of 250 miles overnight in a beat-up old taxi on the dangerous roads of India so he could keep an appointment. That he would trust a young undergraduate enough to say 'you decide which courses you want to take'. Or that he was a man who would jot down some quick incisive thoughts (Spalding Missives) on the train from Wimbledon to South Ken that could take days for us, mere mortals, to unravel. Brian was all that and much more. An accomplished poet. An excellent squash player. A very good swimmer.

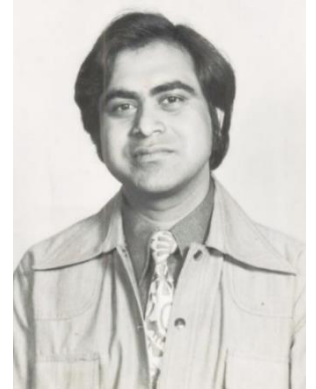
Whatever Brian decided to do – and he decided quickly – he did with gusto.

Brian said he would want to be remembered for his poetry. That may well turn out to be so. But surely, Brian's contribution to science will be remembered for generations to come. Most scientists make their mark in a niche and distinct field. Not so with Brian. Although he is most recognized today for his contribution to the field of CFD, what is less known is that this was just the icing on the cake because, by the time he turned his attention to CFD, he had already made his mark in multiple fields of science and engineering. First he made seminal contributions to Combustion; this led him to the theory of Mass Transfer where he has the rare distinction of having a non-dimensional number (Spalding Number) named after him. He then unified the basic theories of fluid flow, heat and mass transfer which led him, finally, to CFD.

For me personally Brian was not just an Icon but a living legend. His nurture and mentorship led me to where I am today. His advice to me, to concentrate on what needs to be done rather than on the obstacles to the doing of it, has been a guiding beacon.

Though he was born in a land far away, I found his advice to be so much in tune with the teachings of Bhagvad Gita which – for me – is the book for living a conflict free life. I considered him my intellectual father and I miss him in so many ways.

Brian once made a memorable statement that stayed with me. Man inhabits Fluid and Fluid inhabits Man. Now Spalding permeates this fluid space. Alas, he is no more but his legacy will endure for a long time.



*Akshai Runchal, PhD (1965-68) Student of Prof D B Spalding
Professor, CFD Virtual Reality Institute,
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How DBS shaped my Career: Brian Launder

The first occasion I heard DBS speak was just before Christmas in 1960. I was a final-year undergraduate at Imperial and he was the young professor of heat transfer. On that day his declared intention was to brief the soon-to-graduate class of mechanical engineers on research opportunities the department offered. Only for me, it didn't quite come out that way. The college was constructing a new department while progressively demolishing the old Victorian building on the site. While I'm sure Brian spoke of the various research projects that were available, what especially stuck in my mind was his saying that, with all the rebuilding, any new PhD student should expect to encounter a delay of at least a year.

I was in a hurry and that made me realize at once that postgraduate studies at Imperial College were not for me. A class friend remarked that he'd thought of going to the USA for postgraduate work which seemed a brilliant idea. So, I applied to a half-dozen American universities on or near the East Coast (to minimise the distance from home) and two months later offers of admission started to arrive. What particularly attracted me was a named scholarship at Princeton but I also received an offer of an assistantship at MIT. Which to choose? Clearly, Professor Spalding should be consulted. Graciously, his secretary allocated me a 5-minute slot. After I took a minute to explain my fortunate position, Brian responded with:

“Princeton has Robert M. Drake... but he’s never had an original idea in his life. Go to MIT with Rohsenow!” So, reluctantly I declined the Princeton scholarship, did my doctorate at MIT... and have never regretted it!

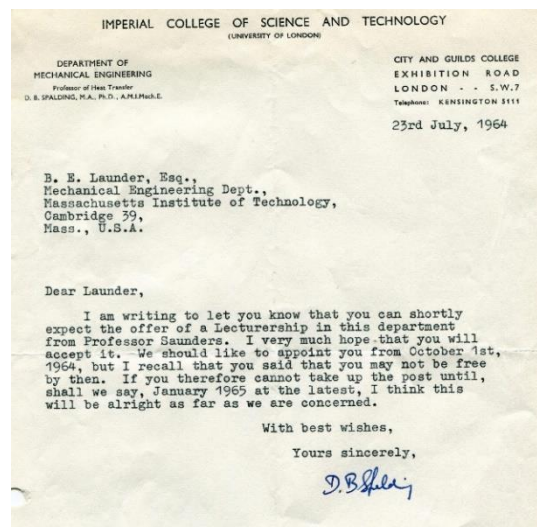
Nearing the end of my doctoral research the question of ‘what next?’ loomed large. I’d been offered research positions in government labs but none ticked all the boxes. So, since I was making a brief return to the UK, I called at Imperial College to ask DBS whether there might possibly be an interesting position with his group. He gave me an inscrutable smile, said he’d look into the possibility and let me know. Within two weeks, back in the USA, I received a letter from him (Fig. 1) advising that I would shortly receive the offer of a lectureship in his group. What an important, life-changing letter that proved to be!

He also smoothed my entry into the post, first by assigning me the ‘soft’ lecturing assignment of the master’s level class and, most importantly, for my administrative task, handling all research applications to the group. The latter meant that I had first sight of the cases of all aspiring research students – which enabled me to recruit as my first students Kemo Hanjalić and Bill Jones both of whom carried out outstanding doctoral research and have gone on to stellar academic careers.

About three years after my entry as a lecturer I discovered that a colleague who in my perception made far less of a contribution to the group than I did was, nevertheless, paid substantially more. At the first opportunity my grievance was raised with Brian. He sympathetically sat me down and in a rather avuncular manner explained that lecturers’ salaries were largely based on age. To sweeten the pill, he mentioned he had a request from UKAEA Harwell to provide a version of his new GENMIX program that could compute condensing turbulent flow in vertical tubes for a steam mixture containing non-condensing gases. He continued: “I’m too busy to take on this job ... but if you did the programming, I’d be able to advise you whenever you encountered a problem. The project did indeed proceed smoothly and, on completion, I received the promised addition to my salary.

However, the project did far more than that: GENMIX just has the mixing-length model of turbulence and inadequacies were all too apparent. Thus, having been exposed to the beginnings of CFD through the Harwell consultancy, I was ready to engage with my students Bill and Kemo in developing far more general turbulence modelling schemes, the area where much of my research over the subsequent half century has been directed. And, for that opportunity, I will always be grateful to Brian.

Fig. 1: Letter from Professor Spalding announcing the imminent offer of a lectureship in his group



A Story from the 1980's: Arne Holdo

In the late 1980's, I was moving back into academia after several years in industry. Whilst working in industry I understood the scaling issues of physical testing of large applications and as many others at the time I saw the potential of CFD in the design process and tried to introduce CFD in my industry.

Once back in academia it was necessary to present and publish work, and it was at a CFD conference in Europe that I met DBS for the first time. I remember that my presentation focused largely on the physics and physical parameters of the application rather than the numerical and CFD-specific modelling issues. After listening to many co-presenters, I felt that this was a weakness and was not too happy when it was my turn to present.

I knew DBS by reputation and the work he had done to establish CFD and was really concerned when he was about to question me after my presentation. I need not have worried, instead of a hard line of questioning and criticism. DBS came with compliments and positive helpful suggestions on how the work could be extended, reinforcing my belief in an academic working life.

During the following years I and some of my students had the pleasure of working with DBS on several occasions. We had the benefit of his help, expertise and positive thinking and I always felt that a meeting with DBS gave inspiration.

This little story illustrates the way DBS was as a person, scientist and academic – helping and supporting others with knowledge, understanding, encouragement and ideas. He was not only a world leading scientist, but also a very good human being.

Arne Erik Holdø

Professor D. Brian Spalding: Jill Rayss

I met Professor Brian Spalding in 1989 when I commenced work with him as his Personal Assistant, a job which I held for just over 27 years. I have a lot of memories of working so closely with Brian on a daily basis. Some of these I am happy to share, others will remain locked away in my memory, simply because I was his PA.

Everybody who knew Brian, knew he was a workaholic. He was at CHAM seven days a week when in the UK. In the early days, on a Monday morning, my desk would be covered with technical writings he had produced over the weekend. His handwriting became more and more illegible; I frequently had to ask him what something was, and he could not always read it himself. It was a nightmare getting him to deal with his commercial correspondence and our sessions dealing with this were short. Things got better with the onset of email, but I had to make amends for some emails that slipped through, especially over the weekends, comments that come into the category of “you can’t write this”. He nearly always appeared somewhat shocked when I pointed this out, human resources and policies/practices were not his forte.

There were days I would hardly see him; he would be shut away in his office concentrating on coding or lecture writing, only emerging to get a cup of coffee. Frequently he would say “have I not said good morning to you”, when I would knock on the door to say “goodnight”; he always looked at his watch whenever I said I was leaving. When Brian was on an overseas trip, it gave me the opportunity to go into his office and tidy up, I don’t think he particularly liked to find on his return that papers had been moved. It would be during these times that on many occasions I found verses of poetry that he had written. I suppose I was lucky to have a sneak preview of these.

Brian was courteous as a boss, and always expressed gratitude, that is not to say, he couldn’t be difficult. If he made up his mind to do things his way, he wouldn’t be moved. He was thoughtful and nearly always brought me back a bottle of Russian Vodka from his frequent trips to Moscow, which I would find waiting for me on my desk.

Brian disliked disrupting his time in the office for mundane tasks, like taking his car to the garage, paying online bills, going to the bank, or organising the servicing of his caravan, and he was always ready to pass this on to me. Over the years I helped him with numerous personal tasks. One of the last things I did was go with him to the florist to purchase flowers for Colleen’s birthday. On returning to the office, he didn’t think that there were

enough flowers, so he sent me back to order some more.

At Christmas CHAM, like many companies, sent numerous Christmas cards; getting Brian to sign each and every one, (which he eventually did) was an annual nightmare. Christmas parties were held, but the only photograph I have of Brian and I was taken at CHAM in 2011, after a staff leaving presentation; I share this with you here.



In later years, Brian would ask me not to come into his office while he took a short rest, or was getting ready to go to Pilates. I did however catch him a number of times working out on his treadmill which he had in his office.

The final message I received from Brian was an email after he arrived in Moscow on his last ill-fated trip. It was a ‘thank you’ for organising his travel and hotel and said his journey had been uneventful.

I knew Brian as a well-respected and eminent scientist, a business man who would discuss everyday issues, and as a family man who would share family moments, his pride at receiving his various awards and his sadness at personal loss. He was a kind and generous man whom I felt very privileged to know and thought of with great affection. He came from the same era as my own father, both born in 1923, and both deceased in 2016. Like my father, he always wore a suit and tie to the office, the dark one in the winter, and the light blue one in the summer. Always the ‘true gentleman’. I still miss him very much.

Brian’s office at CHAM is now unused, but his white board still bears some of his technical coding, his armchair, blanket and walking stick are still there. I am not sure he would entirely approve as although his office is still full of his papers there is no room on his desk for his computer!

Finally, on what would have been Brian’s centenary, I would like to say “Happy Birthday” Brian, wherever you are. You may not be here in person, but you are still remembered and missed by your family, by CHAM, and the wider scientific community.

From Russia with Love: Inna Syrous

I was lucky to get acquainted and communicate with Brian Spalding within the framework of the presidential project of the Global Energy International Prize. It is awarded to scientists around the world for outstanding achievements in the field of energy. Brian, as a high-class expert in this field, was invited to join the International Committee, which evaluated scientific papers nominated for the Prize. I was engaged in the organizational activities of this committee and thanks to this I had the opportunity to observe the meetings of scientific world luminaries, as well as participate in related events.

In my eyes, Professor Brian Spalding was a committed and disciplined man who never missed a meeting. Despite his advanced age (he was the oldest Committee member) Brian participated with great enthusiasm in long meetings and, in a limited time, was able to study scientific material in detail, analyze it, draw appropriate conclusions and make a decision. Moreover, taking part in scientific discussions he spoke very quietly, but so simply and convincingly (he was hitting right on target), that after his comments no one needed to add anything on the issue.

I once witnessed a scientific discussion that reached an impasse. All were exhausted by heated debate during a long meeting. The participants didn't have the strength to continue. You know what happened? Brian just took the floor and told a joke. In my opinion, the anecdote was not very funny (if not completely unfunny☺), but due to the unexpectedness of what they heard and because of fatigue, everyone laughed like they had probably never laughed in their lives. This greatly relieved and improved the situation. The Committee continued its work.

Brian had to travel a lot. I did my best to be able to meet him and see him off at the airport. With each visit to Moscow or St. Petersburg our meetings moved more from an official status to a friendly one. Communication with him was such a great pleasure. Once, when meeting at the airport, we were so carried away by the conversation and news exchange that we left the airport without his luggage. He remained completely calm even in the most unpredictable situations. It's OK, we got back to the baggage claim hall in a slightly unusual way (we used exit) and took his luggage with a colored ribbon on the handle, that was carefully tied by Colleen I suppose.

In Russian culture (I'm sure not only Russian) there is a long-standing dispute between physicists and lyricists. This is a struggle between two irreconcilable sides of the intelligentsia, classifying themselves as opposite types of mental organization. Physicists and lyricists, techies and

humanitarians, scientists and poets have been arguing for many years about whose achievements have the greatest impact on this world and who of them is more important. Brian Spalding is a phenomenon that reconciled the two. Brian is brilliant! His poems are love, irony, philosophy, reflections on faith and hope, and God knows about what else. They are life itself despite the fact that he wrote about death as well. For whom is it written? For men and women, youths and elders, people of any nationality, religion, and marital status. For all of us. I am immensely proud that I am the happy owner of his several books with a dedicatory inscription of the author himself.

Acknowledgements

I am grateful to fate, which gave me the pleasure of meeting Brian, and later Colleen. I am grateful to the Spaldings for their warm hospitality extended during my stay in London in 2012. Such meetings are very valuable.

I am very grateful to Brian for the fact that for me personally he was an example of love of life, hard work, conscientious attitude to duties and hobbies, for his peculiar sense of humor☺, inexhaustible desire and phenomenal ability to communicate with people of other generations, cultures and societies.

And, of course, I am grateful to Brian Spalding for his attachment to Russia, for his love for the Russian language and culture. I'm sure the love was mutual.

**Inna Syrous, Department for International Cooperation
Russian Academy of Sciences**



To Colleagues and Friends: Jalil Ouazzani

Today, we gather in writing throughout the world to celebrate the 100th birthday of Brian Spalding, a true pioneer in the field of CFD and a giant of engineering.

Professor Spalding's contributions to CFD are immeasurable, and his legacy continues to inspire generations of engineers and scientists. He was a visionary who recognized the potential of numerical simulation in fluid dynamics long before it became a mainstream field. His pioneering work on the SIMPLE

algorithm revolutionized the way in which engineers and scientists approach fluid flow simulations.

Throughout his illustrious career, Prof Spalding made numerous seminal contributions to CFD. He was a prolific researcher who published over 160 papers and authored several books. He was also a passionate educator who inspired countless students to pursue careers in CFD.

Professor Spalding was not only an intellectual giant, but a true gentleman and scholar. He possessed a rare combination of intellectual brilliance and humility. He was always willing to help colleagues and students; his generosity and kindness are sorely missed.

I met Brian in 1987 in Alabama. Since then, destiny chose to let us share space and continuum through conferences in Wimbledon, Moscow, Luxembourg, Minneapolis, Huntsville, Paris, Marrakech, meetings for the development of PHOENICS, and creation of companies representing CHAM, ArcoFluid (Bordeaux, France), ArcoFluid Consulting LLC (Orlando, Florida).

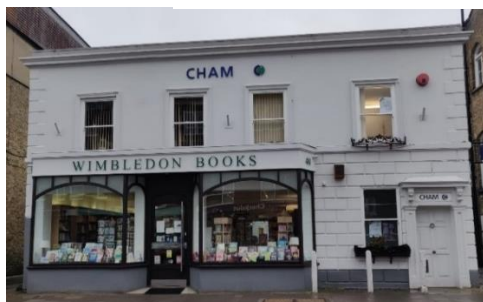
CHAM

CHAM, and Bakery House, were central to Brian's life for years. He was never happier than when at CHAM 7 days a week. Our Head Office *was* a Bakery. It then housed a laundrette which closed and we occupied the site. Later, whilst book shopping, Brian learned the bookshop he used was closing due to rent increases. He offered the owners CHAM Reception (and my office!) – It was “the Right Thing To Do” - *and* it enriched Village Life.



Bakery House when it was a Bakery

Bakery House in the 1970s



Bakery House 2023

Working with Brian – The Way it Was: Michael Malin

For the centenary of Brian's birth, I thought it might be interesting to describe what it was like to work closely with him on CFD activities. First, Brian was not easily satisfied and often he could be difficult to work with because he could set challenging tasks, sometimes with minimal description, and always with the expectation of high standards in execution and reporting. Such an experience could be also be characterised by sudden and extreme changes of direction, which sometimes meant starting afresh with a completely different methodology, by creating a new CFD code, or by introducing novel physical models, or worse still, sometimes all three of these. In return for this exacting experience, one's knowledge was enlarged considerably, and there was also the potential reward of witnessing Brian's stunning creativity, intuition and flair, which extended over a vast range of subject matter. This was matched only by his immense knowledge of all things involving thermofluids, including chemical reactions, multiphase flow and that nemesis of many a CFD engineer, thermodynamics.

The foregoing may sound quite daunting, and not for the faint hearted, but apart from the technical benefits, so many CFD activities were littered with utterly memorable incidents and examples of Brian's genius and sense of humour. From personal experience, I could give many detailed accounts; here there is neither time nor space so the few examples provided below will hopefully suffice.

I became involved with PhD students who visited from Imperial College; and I can recall receiving a memo from Brian about a draft PhD Thesis submitted by one talented student on the development of a general curvilinear coordinate system. The memo ran something like “*Mike, this student may ask you to ‘correct’ his English. My advice to you is ‘don’t try’. He seems to imagine that someone else, by improving his English (which is not bad) can repair the deficiencies of argument and explanation. It is not possible!*” Sometime later the student phoned me to say that he was pleased that Brian thought his Thesis was well written; but the really bad news was that in the interests of demystification, he was now engaged in the arduous task of re-writing his entire mathematical description to use vectors rather than tensors.

On another occasion I got drawn into a contract which involved 2D laminar, multi-component gas transport and chemical reaction with the flame impinging on a rotating surface. This work was beset with convergence problems, and then, when simplified, the thermal solutions were

implausible. There was nothing for it but to undertake a crash course in the subject to gain a complete understanding of the required physical modelling. This was done by deciphering the celebrated book entitled 'Combustion Theory' by Professor Forman Williams. Despite the brevity of the mathematical description, this book proved invaluable, but I was surprised to discover the following words in the Preface: "*Professor D. B. Spalding contributed many helpful suggestions and kindly read the first draft of the manuscript, recommending many important changes*".

It was now time to review the contract and its technical problems with Brian. This was always a risky business, but on this occasion the benefits were manifold in terms of ideas, suggestions and possible solutions. Afterwards, the customary memo arrived, which concluded with: "*This is a job which requires very close supervision. You might find it easier to do it yourself. I would find it easier to guide you, than someone else through you.*" Following this advice brought the contract to a successful conclusion.

Brian then sought an audience with the Client at the review meeting. This proved memorable for the way in which Brian convinced the Client to abandon any detailed flame modelling; and instead proposed a CFD model of the entire industrial process with the flame represented as a stream of hot gas, and the rotating cylinder treated as a fluid having different properties and a prescribed velocity field. Brian did this by grasping very quickly the essentials of the entire system, suggesting potential design problems; and then running through different design scenarios based on the input parameters to his proposed model. Not long after the meeting, I received a long memo which concluded with "*We ought to be able to give our Clients good advice on what to do and what to abstain from*" and further, "*we should expect to hear less from our engineers of the Client wants X*" and more of "*the Client has asked for X but I persuaded him that Y would serve his purposes better.*" I still think to this day that only Brian could have carried this off with his unmatched physical insight, his technical knowledge and creativity, and his eloquent powers of persuasion.

Last, but not least, thank you Brian for making many ruthless and savage demolition jobs of my technical reports with your renowned red pen. Eventually, after many years of re-writing large sections of my reports in accordance with your advice, I was elated to receive the following response to one of them: "*This is a well-organised, well-written and interesting report on work which appears to have been excellently conducted. We must make more use of your writing abilities at CHAM*".

This leads me to the time when a few years later I submitted my draft PhD Thesis to Brian, who was both my supervisor and internal examiner.

The manuscript was met with the following praise: "*The Introduction is one of the best I have ever read for a PhD. It bodes well for the rest of the thesis, so I don't need to read any further.*" After the viva at Imperial College, I was called back into the examination room and Brian announced that I had nothing major to worry about, but that both he and the other examiner felt the Introduction was unsatisfactory, and that it needed to be revised according to their criticism, which would follow shortly by mail. From this, I learned to expect the unexpected whenever Brian was involved, but then I'm thinking I should have known that already.

Dr Michael R Malin, CHAM

In memory of DBS: Andrew Pollard (1975-1978)

"One hundred years of solitude" is the title of a famous book which is said to be, by Wikipedia, "the novel is often cited as one of the supreme achievements in world literature". On reflection, for me, while Brian would have been 100, "solitude" is the antithesis for Brian's impact on those of us who had the benefit of reaping the rewards from an incredible person and mind over many years. His ability to not only create, but then selflessly to share and communicate with style, wit, precision, and clarity the fruits of his mental labours is a trait equalled by few. His achievements have been globally recognised so no more needs to be said. However, his impact on individuals during his lifetime extends far beyond his research students, for they begat others and now, some of these have great or even great-great academic grandchildren. Personally, I take great pride in mine, many of whom continue significantly to influence their scientific and engineering fields of endeavour.



As a testament to what I think was an enduring connexion, we shared many drinks, meals, special occasions, and discussions technical, poetic, and historical. There was one occasion over dinner when, to

his horror, our server repeatedly returned when it was determined that each of his credit cards was maxed out. He was embarrassed, and I noted an uncharacteristic lack of attention to detail, but we laughed and I had the pleasure of paying the bill..... a meagre amount given the investment he made in me!

andrew.pollard@queensu.ca
<http://me.queensu.ca/people/pollard>

Remembering my Doctor Father Brian Spalding: Wolfgang Rodi

I met Brian Spalding first in 1967 when I spent a year at the University of Minnesota where Brian gave a seminar on Numerical Flow Calculations. I was so fascinated that I applied to him to pursue a PhD study on the topic. He accepted me and became my doctor father and gave me as a research topic: the development and testing of turbulence models. This is what then occupied me at Imperial College for 5 years during 1968 – 1972. I was extremely fortunate to have this opportunity as it gave me the privilege to participate in one of the most exciting and momentous developments in fluid mechanics at the time - the birth of Computational Fluid Dynamics (CFD) with Brian clearly being the father, bringing in all his vision and creativity. It was indeed an exciting and in fact turbulent time, sometimes a bit tough for me, as it was not easy to follow the pace of Brian. It laid the foundations for my later career as Brian put me on the increasingly important subject of turbulence modelling and taught me how to work and how to write. He was not too happy with the first draft of my PhD thesis so that his legendary fountain pen left a lot of red ink on the margins, which was disconcerting at first sight but provided very clear and helpful instructions on how to improve the writing. I followed these and he was then much happier with the second draft and I got an early taste of his talent to write poems. I had abbreviated “equation” as “equat” which reminded Brian of 19th century comic verse and stimulated him to write on the margin:

*The Akhund of Swat
Said “Please tell me what
(For I’ve quite forgot)
Is an equat?
Does it stand or squat,
Smoke hash or pot?
If it drinks a lot
I would much rather not
Receive it in Swat.”*

After I finished my PhD, Brian wanted me to work for a newly established software company in Germany, I think related to Prof Argyris, but I had an attractive offer from

the University of Karlsruhe (now Karlsruhe Institute of Technology), which I accepted and stayed there. I kept in contact with Brian; we exchanged scientific ideas and publications, and met at various conferences.

In 1988 Brian helped with the birth of ERCOFTAC (European Research Community on Flow, Turbulence and Combustion) and choosing its name. He became the first chairman of its Scientific Programme Committee and put ERCOFTAC scientifically on track. At that time, he got me involved. I remember on a flight from a meeting near Turin we discussed what role I could play; he put me in charge of test-case issues. I became very active in ERCOFTAC, an involvement that continues now in my role as Editor of ERCOFTAC’s Knowledge Base Wiki.

My subsequent encounters with Brian were mainly at various celebrations and events: 1988 at Brian’s retirement dinner in South Croydon and in January 2003 his 80th birthday celebration in Richmond Hill where I presented him with an ERCOFTAC pen.

I was pleased and honoured that he came to my retirement event in Karlsruhe in September 2007 and gave a philosophical talk on my work in turbulence modelling – see him in action in the first photo. His presence was certainly a highlight of the event and appreciated by the many other participants in the group photo where Brian is surrounded by the Rodi family (on the left by me and my wife Helga and on the right by my son Daniel).



In the evening Brian enjoyed and endured the party even though he had to travel to Russia next morning - the photo shows Brian with me and two buddies from Imperial College, Brian Launder (left) and Bill Jones (right).



In 2008, Brian was the after-dinner speaker at the Banquet celebrating the 20th anniversary of ERCOFTAC in the Belgian Royal Academy in Brussels, appropriately dressed in a dinner jacket and ingenious as ever. Afterwards we went to a bar where a glass of whisky loosened his tongue. Also in 2008, we had a very enjoyable conference in Marrakesh on the occasion of Brian's 85th birthday. We celebrated his 90th birthday in 2013 with a dinner at Imperial College, where he delivered an interesting and entertaining autobiographical poem summarizing the key elements of his life. Poetry was one of his great passions and talents, and my wife and I are very happy having received from him several books with his poems (some bilingual – half in Russian); these are real treasures on our bookshelf.

The last time I met Brian was at the ETMM11 conference in September 2016 in Palermo where, at the age of 93, he attended many lectures, asked pertinent questions and delivered a lecture on combustion modelling. We sat at the pool talking about the early days of ERCOFTAC and I was also fortunate to sit near him at conference banquet, enjoying his reciting German songs. My chair is empty in the photo of Brian at the table because I was saying a few words on this very special conference participant, expressing the hope to have Brian back at the next ETMM conference in 2018. This unfortunately could not come true; my wife and I as well as the whole fluid mechanics community are very sad about Brian's departure and we all miss this great man very much.

Wolfgang Rodi

Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany



In tribute to Professor Spalding to Whom I Owe So Much: Amr Serageldin

Professor Spalding was my direct PhD Thesis supervisor throughout the years 1973-1977. I was very fortunate to learn first-hand from the “father of CFD” the intricacies of the subject when CFD was in its infancy. Upon my return to Cairo University, Egypt, I disseminated this knowledge to colleagues and students; over the years hundreds if not thousands of researchers and engineers have benefitted indirectly from his teaching. - many made a livelihood out of it. This scenario has probably been repeated in most countries of the world and it can't be underestimated. However, I will focus this article on the less known non-technical and humanitarian side of Professor Spalding.

One of my first episodes with Prof. Spalding was while I was queuing in front of the lift of the MechEng building. Professor Spalding was heading quickly for the stairs when he spotted me, so he circled back and headed towards me to inform me that he would like to offer me a research grant, and if I was interested, we could meet and discuss, then returned back quickly to take the stairs even though the lift had just arrived. First, I was struck with his modesty in the way he offered the grant, then at his fitness to take four flights of stairs instead of waiting for the lift, and further his ability to reduce his trip time, while simultaneously getting physical exercise and delivering his message; a typical model of his optimization skills! On another occasion, when we had to deliver our first presentation to a board of directors from RR who were sponsoring our research, we walked across Hyde Park to the meeting venue; during this half hour of *brisk* walk, we went through the presentation, he tipped me on what I should expect and avoid, and the nature of the audience I will be facing; on our way back, we discussed the outcomes of the meeting and my research work. Thus. in addition to delivering the presentation, I was taught first class presentation skills, 1 hour of research guidance and reporting, as well as one hour of exercise and an example of efficient time management!

Professor Spalding had a secretary called Sue who was typing a paper on Combustion when she stopped typing (those days we only had electric typewriters) and announced: “that's it, I will not type one more word until somebody explains to me what is Combustion”, and lit a cigarette. Professor Spalding stepped out of his office, picked the matchbox lying beside her, lit a match and said: “that is combustion”. Sue was satisfied with the reply, and went back to typing. Professor Spalding had given her all the knowledge she needed, satisfied her ego, and in less than a minute of his time.

During a family visit to Egypt, he made a remark that I shall never forget. He was very impressed at the advanced level of engineering and medicine the ancient Egyptians had reached some four thousand years back; however, he asked: “after reaching such a developed level of Science and Civilization, why didn’t this development continue during the following thousands of years?” I bet that among the millions of tourists we have had visit Egypt over the ages that question never arose in anyone else’s mind. DBS’ mind was always ticking - holiday or not.

DBS was a master of simplifying complicated matters and breaking them down into treatable structures; it showed in his research and in his way of life. Apparently, this started early in his life. He once informed me that when he was a young school boy his favourite game, and one in which he was particularly good at, was one in which the players formed two teams, each team given a set of ropes which they entangled as best as they could; then the opposite team would be required to untangle those ropes. The team that untangled the ropes first would win.

DBS was interested in humanities as well as science. He had a knack for learning foreign languages and spoke a few. The story goes that, on a long flight, he passed the time learning Russian via a teach yourself book. By the end of the flight, he had learnt Russian and also left comments to the author on how to write a better book.

Although DBS had a very crowded timetable, he always managed to find time for his students, and to respond to all communications timely. As research students, we could ask for a meeting any time, however it should be preceded by a short report defining the exact problem, actions that were taken to tackle it, and the results of those actions. The report forced us to analyze the problem source properly and attempt to solve it systematically; by the time we finished writing the report we usually had solved the problem on our own. That I guess was precisely his way to get us to work more efficiently and to learn to solve our problems on our own. It also taught us effective reporting, while saving some of his precious time.

Brian was also very compassionate, friendly and social. He paid personal attention to each of his employees and students and gave each individual attention, showing interest in them and their surroundings, and even finding the time to meet their families. He is truly an unforgettable figure whose memory will always remain in the hearts of those who have known him.

***Amr Serageldin, Prof of Thermofluids and Energy
Mechanical Engineering Department, AUC, Egypt***

Brian Spalding on the occasion of (what would have been) his 100th birthday: Steven Beale

With Brian at Alcatraz



It is hard to explain Prof Spalding’s extraordinary achievements, or the large number of peoples’ lives and careers he touched, to those unfamiliar with the strange and marvellous art which he created and practiced.

Engineers are not, by and large, renowned for their fame! Suffice it to say, in my lifetime, the state-of-the art of fluid mechanics and heat transfer has changed profoundly; from narrowly-focussed efforts to obtain analytical solutions of complex equations over limited ranges-of-application, to the practical solution of a vast array of real-life applications obtained with modern computers. Brian had a great deal to do with that transformation which, like the “Energiewende”, is still unfolding today. He, alone, against great opposition, insisted it was possible to develop general-purpose computer programs capable of solving any and every problem in thermo-fluids. That was game-changing.

The sheer breadth and depth of his knowledge were quite extraordinary: Most researchers are lucky if they make an impact on one or two subjects in a lifetime; Brian’s ranged across a whole swath of activities; from combustion and detonations to hydraulics, turbulence, aerodynamics, heat and mass transfer, construction (building ventilation), bio-medical applications, energy and the environment; he led the field on, not just one, but a whole new wave of practical solutions. Yet Brian himself was acutely aware, not only of the scope, but also the limitations and the shortcomings of CFD. In one of our last meetings, he indicated how “worried” he was becoming, as “people are starting to believe their own results”. He himself would always meticulously check his work, and would expect/insist others do likewise. Though there are many talented people working in CFD today, there is no single person capable to follow his lead (at least not to my knowledge), but rather dozens, hundreds, perhaps thousands of engineers filling ranks that were created by his pioneering work. It is my great regret that he is not here today, as we had all hoped he would be, to celebrate an extraordinary life of achievement. I join many others here, in a salute of appreciation to Prof. D. Brian Spalding on the 100th anniversary of the occasion of his birth.

Steven Beale, Jülich, December 2022

A SIMPLE Revolution: Fond memories of my association with Prof D B Spalding: Pratap Vanka (formerly V S Pratap)

I shall begin my write-up by first wishing Prof Spalding a Happy 100th birthday even though he is not in this world with us to celebrate it. We all wished and prayed that he would continue his life until his 100th birthday, but the divine makes the decisions. We very much remember him as if he is sitting and conversing next to all of us. It is said in Hinduism that a teacher is God. But is a teacher really God? Recently, I heard a wise man clarify that to a young student who asked the same question. The Swamiji replied “A teacher is not a God. There is a difference. Reaching God is our goal. A teacher is the way. A teacher shows the way to reach our goal. If a teacher takes us in a wrong direction, we do not reach our true goal. Hence a teacher is very important to our life and livelihood.

I am one of those privileged to have the opportunity of doing doctoral work under the guidance of Prof Spalding. I was fortunate to be at Imperial College in the “golden” era of the development of the SIMPLE algorithm and evolution of engineering CFD (1972-1975). I worked with CHAM for two years when commercial CFD was in a nascent state and when there were no sophisticated graphical interfaces, file management systems or powerful personal computers. These days invoke in me memories of years gone by with the progression of CFD from very coarse grid turbulence on teraflop computers.

I met Brian on Dec 3 1971 in Bombay airport when Suhas asked Ashok Singhal and I to receive and entertain him prior to the first ISHMT conference in Madras. At this meeting he made me a verbal offer to come to England to do my PhD. I arrived at Imperial College on 10 Oct 1972. That was indeed a turning point in my life, a turn that kept me on the CFD path for ever. My thesis was concerned with using the three-dimensional parabolic procedure to study flow in curved ducts. My first work on flow in helically coiled pipes was probably my best regarded. Upon submission to JFM, Prof Lighthill accepted it without external reviews. I still cherish the long (A4) letter that Prof Lighthill wrote on our manuscript submission.

There are many things that I would like to share with you about Prof Spalding. Foremost was his brilliance and insight into scientific ideas and computational methods. He had a very sharp intellect that could even construct science from simulations generated by an incorrect CFD code! I remember occasions when he would explain flow patterns shown by students, only to learn the student had a programming error. Prof Spalding’s brilliance remained

precisely the same between 1972 and 2015, the last meeting I had with him. He was so sharp in discussing and understanding concepts. I remember trying to explain a multigrid algorithm I was working on. He interrupted me and said, “you must be doing this”. I was happy that he already endorsed what I was going to explain.



During the past over forty years of association with Prof Spalding, I always admired his speed of comprehending a problem, thinking through, and replying with a correct answer. The first time I noticed this was in a magic show in Bombay in 1971 when I commented on an act balancing a lady on a pointed edge under the so-called influence of hypnotism. The point of balance was asymmetric, but the lady was lying flat at a height. I wanted to impress Prof Spalding with the powers of Indian hypnotism, but he quickly corrected me (in a few seconds) by saying “but the moments must balance”! His suggestions concerning technical questions on my thesis topic were similar.

Many have also experienced Brian’s insistence on logical thinking, speaking and writing. Brian wanted us always to speak full sentences, precisely, and say what we did, why we did and what we found, in that order. Any other order or imprecise wording was interrupted and corrected immediately. I remember when one day a student walked into his office saying, “It does not work”. Brian demanded that he first define “It”, and “does not work”, and then continue the discussion. I think my own style of thinking, writing, and speaking has considerably improved because of Brian. I do not think my students will work with me if I insist on such high standards with them!

The word SIMPLE as we know is the algorithm which all of us have used. But it is also simple! That is why so many have picked it quickly. SIMPLE revolutionized CFD as we know. It made several millionaires, benefited many companies, many publishing houses(!), and created a clan of users. Meanwhile, the time clock has also completed a partial revolution! At his 85th birthday celebration in Morocco, I commented in my speech that we will all meet again in 15 years at Brian’s 100th birthday. However, the 93 years that he lived were so valuable, productive and influential that we should not feel deprived of not being with him more years! He will live in our hearts through our memories of him!

Outside the Box and Inside the Box: Norberto Fueyo

To those who knew him scientifically, one of Brian's main outstanding gifts was perhaps his ability to think "outside the box". His creative thinking was the origin¹ of the "analogue computers" of Brian's early days; of the "tanks and tubes" analogy that resulted in his formulation of the Finite-Volume Method; of the upwind convection scheme; of his procedure to calculate the distance to the wall (or the distance between walls) using the Poisson equation; or of his multi-fluid and population-balance models of turbulence and combustion, the development and promotion of which were his passion in latter years.

In a jocular poem² he wrote for the celebration of his 90th birthday, he implicitly attributed his creativity to one of his "three kindly lady friends": Laziness (the other two were Restlessness and Ignorance!). While this connection may initially appear as self-effacing, it is not once one realises that Brian defines laziness as "being economical with the effort" or "searching for a simpler way". It then becomes apparent that the driving force of his inexhaustible creativity is his quest for simpler solutions.

In May 2008, the ICHMT (which Brian had helped set up forty years earlier) organised a symposium in Marrakech to mark his 85th birthday. Over a memorable lunch, he reminisced about personal and professional memories, and told me (jokingly, I guess) that he thought his greatest contribution to Science was perhaps the "lecture panel" format, such as the one shown in the image below. (His creation predated, of course, PowerPoint and similar apps by many years; A4 "foils" or "transparency" sheets were used at the time together with "overhead" projectors).

This is the "Inside-the-Box" Brian, and his exceptional ability to add structure to knowledge. This ability is present not only in his lectures, but also in his books, and even in the way he organised the software he wrote.

Reflecting on the occasion of his 100th birthday, I think that this unusual combination of outside-the-box creativity and inside-the-box systematisation is the single aspect of Brian's personality that has had the largest impact on me.

As a tribute I have selected, to illustrate these thoughts, one of Brian's "inside-the-box" lecture panels; one which conveys a good example of "outside-the-box" thinking: his early ideas on the use of multiphase models to represent turbulent combustion.



IMechE 1985	$\frac{4}{12}$	The two-fluid concept of turbulent combustion
<ul style="list-style-type: none"> A turbulent flame is envisaged as an irregular coastline, with many islands and land-locked lagoons. The islands and lagoons can and do <u>move relative to one another</u>; they also grow or diminish in size, and change shape. This behaviour obeys the usual laws of mechanics, relating pressure gradient, inertia, friction, etc. 		

¹ V. Artemov et al, *A tribute to D.B. Spalding and his contributions in science and engineering*, International Journal of Heat and Mass Transfer 52 (2009) 3884–3905

² A. Runchal (editor), *50 Years of CFD in Engineering Sciences - A Commemorative Volume in Memory of D. Brian Spalding*, Appendix I, Springer Singapore (2020)

**Norberto Fueyo, University of Zaragoza
(PhD Student 1987-1990; CHAM employee 1989-1992)**

In Memory of Professor D Brian Spalding: Milorad Dzodzo

Meeting Professor D Brian Spalding – Dubrovnik, 1982

During my work on MSc Thesis at University of Belgrade, in 1982, I was struggling with some implementation details of a numerical method. I seized the opportunity to meet Professor Spalding during XIV Symposium of the International Centre of Heat and Mass Transfer (ICHMT) devoted to Heat and Mass Transfer in Rotating Machinery, Dubrovnik, September 1982. I had a short but very useful chat about numerical issues I was facing. The right words at the right time aided me in overcoming the outstanding issues and the program finally converged.

Study and Research at Imperial College – 1985/86

Written correspondence with Professor Spalding had continued after I obtained a MSc and resulted in a privileged British Council Fellow Scholarship that allowed me to spend the 1985/86 school year and 1986 fall semester, as a research associate, at the Imperial College, Computational Fluid Dynamics Unit, where I studied CFD and observed the very beginning of commercial CFD software creation. Professor Spalding's unique style of efficient knowledge transfer was at that time adjusted to highly specialized visitors who had their own arrival times, planned duration and specific interests.

Unofficial out-of-office lectures by Brian Spalding

Well organized and prepared printed lectures with figures, diagrams, and short notes, (predecessors of today's popular Power Point presentations), were available and recommended to newcomers, followed by an assigned list of papers and reports. After that, one-to-one office consultations, scheduled a week in advance, were the most prized learning opportunities.



Navy visitors were scheduled to visit IC CFDU. On the morning of the visit posters were positioned in the entrance hall of Tizard dorm across from IC MechEng. By afternoon, some posters were damaged and, on those left intact, pacifist protesters wrote messages against the military. The standstill was broken when Professor Spalding calmly took a piece of paper from the floor, figured out to which poster it belonged, placed it back and kept it at the right spot and asked the planned presenter to start their presentation with an apology to the visitors and an explanation that we needed to change the order of presentations due to the unplanned circumstances.



IC CFD Unit Poster Session April 1986. L to R: Dr Heqing Qin, CHAM; Liu Jun, PhD student; Jeremy Wu, PhD student; Denis Asimakopoulos Visitor; Milorad Dzodzo, British Council Fellow Scholar; Dr Sam Pun, IC CFDU, Dr Tony Ma, IC CFDU

Later, from time to time in my career, I encountered similar situations where a sudden loss needed to be recovered. The difference was that now I was on the spot to lead by example. I would like to thank Professor Brian Spalding, for that unexpected out-of-the-office lecture.

Acknowledgment

I would like to thank Professor D Brian Spalding for guidance throughout the specialization at Imperial College, and for the privilege to experience a unique educational approach resulting in a step-by-step gradual increase of problem complexity which, at the same time, gave me the freedom and time to follow my intuition, search the literature and explore alternative approaches.

I am grateful for hospitality, tolerance, encouragement, advice on how to approach problems using various methods and techniques to, hopefully, get almost the same solution. Last, but not least, I am thankful to realize that technical writing and clarity can be always better.



**Milorad B. Dzodzo
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A Contribution: Dejan Radosavljevic

Every now and then, we get asked a simple question: "Who are the people that changed your life?". For me, Brian comes close to topping that list. In the summer of 1984, my mentor Prof Zoran Zarić and I were looking at how we might apply emerging CFD technology to the design of a new power plant in Serbia. An early champion of CFD in the Balkans Prof Zarić, a good friend of Brian, arranged for us to meet at a conference in Dubrovnik. Brian patiently explained the physics required to model the processes we'd need for our project, and how all could be done with CFD. I was hooked. Coupled with Brian's charisma, the pull of this new technology was irresistible and I soon visited CHAM in London to develop what I'd learned. The plan was to go back to Belgrade to continue working on both the power plant project and my PhD. But tragedy struck. In December 1985, fresh off a long-haul flight from Japan, Prof Zarić passed away. As the only sponsor and supporter of CFD in Serbia, his death destroyed our plans and left me looking for alternative avenues to pursue.

Brian stepped in. He offered me the chance to come to London and continue my CFD work while completing my PhD. Considering he needed to secure funding, employment paperwork and headcount approval from Imperial College, this was a considerable challenge. On top of that, my wife and I had just had a baby and I wasn't keen to leave my family behind. Brian also found a way for me to bring them along. All this was done in 6 months to ensure I arrived for the start of the academic year.

I couldn't believe it. How could this person who barely knew me be prepared to fight so hard for my future? I'll never know what Brian did to get me there, but in October 1986 I started my job as a CFD Research Assistant at Imperial College. The rest, as they say, is history. Thanks to Brian, my family and I have built our life here in London. I often think about how lucky I was to meet him – and, while I know I can never repay him, I'll honour him always by keeping his memory alive.

Memories of Professor Brian Spalding: Siva Parameswaran

I went to Imperial College in September 1977 to do a MSc in the Heat Transfer section on a Commonwealth Scholarship. I took the course “Numerical Methods” under Professor Spalding. I enjoyed his lectures and his teaching style. For example, it is well-known that the linear-equation iterative, solver, Gauss-Seidel algorithm, will slow down with the increasing number of equations, ie it would take more iterations to converge with the increasing number of equations. Brian would demonstrate this with 1 and 3 unknowns for a simple heat conduction problem discretized into finite difference equations. He had a way of explaining complex numerical properties in simple terms; and could convey very complex ideas in simple forms - a skilled teacher. I adopted some of his teaching techniques in my lectures.

Professor Spalding persuaded me to continue my doctoral work in analyzing fluid flow with a non-orthogonal grid with matching non-orthogonal velocity components. I was the first student in his group to use a set of non-orthogonal velocity components to describe the velocity field of the flow. It took me some time to work out all the centripetal and Coriolis forces associated with the directional change of the velocity components. However, this work prepared me for the academic career that I pursued at Texas Tech. I am grateful to my friend, Dr Mike Malin of CHAM, who patiently edited my PhD thesis for technical and grammatical errors.

In 2013, I organized a small celebration for Brian’s 90th birthday at Texas Tech University and it was the last time I met him. A few of his former students, Drs George Carroll, the late Tim Maxwell, Richard Sun, and Lien Tam, joined us in celebrating Brian’s birthday. I will miss him.

Snapshots of Brian Spalding: Susan Maxwell

These are from the Texas Tech Conference held in honour of Brian Spalding in 2013 and were sent by Susan Maxwell whose late husband, Tim, was one of Brian’s IC students.



Tim & Suzan Maxwell, Colleen & Brian Spalding, Siva & Melini Parameswaran, George & Linda Carroll



Tim & Susan Maxwell, Colleen & Brian Spalding

Evidently, as the Conference it was said that, whilst Professor Spalding treated his (ex)students as peers, they still treated *him* as Professor Spalding.

Snapshots of Brian Spalding: George Carroll

We have good memories of Professor Spalding, His influence spans generations. We made a living on what we learned from him. My son was able to get his PhD in CFD and I hope to get my grandson started with it.



Brian and George Carroll at Brian’s home

Tribute to an Academic Luminary; Late Prof D B Spalding, FRS, FEng: O J Ilegbusi

It gives me a great pleasure to pay tribute to my mentor, Professor D B Spalding, FRS, FEng (DBS) on the anniversary of his 100th birthday. I hope that together we may acknowledge and share both our joy in the gift that his life was to those of us who had the privilege of knowing him, and hope that his legacy endures. In sharing the loss and hope together, may we fondly remember more clearly the joy of his finishing the race of life with flying colours? It is now up to us to emulate him as we exact ourselves vigorously to finish the race ahead.

When I heard of Prof Spalding’s passing on November 27, 2016, my immediate thought was that the mighty had fallen and a giant tree in the forest had passed on. There are many great things that need to be said about DBS. I hope that some of my thoughts about him will echo those of other associates and family and my apologies for important details that I might leave out. DBS was a scholar

par excellence, great researcher and thinker, brilliant innovator, successful education leader and administrator, acclaimed poet, dedicated father and husband, tireless advocate for the welfare and progress of his students and associates. He was a man of consummate scholarship, enviable creative energy, and prodigious capacity for execution. He was indeed the luminous tower of academic and research light who laid the foundation for the field of Computational Fluid Dynamics (CFD).

I met DBS upon joining his research group as a graduate student at Imperial College in September 1980. However, my first knowledge of his larger-than-life status predated my arrival in England. I had the opportunity to use a CFD code that was based on the Tri-Diagonal Matrix Algorithm for my undergraduate final year Design project in Nigeria. I was fascinated by this new tool and wanted to pursue a career in CFD. My project adviser said, "I suggest you apply to Imperial College to work with Prof Spalding, the father of CFD who actually developed the code you used." That was how IC became my one and only choice for graduate school and I have never regretted the decision.

I learned through Prof Spalding the enormous power of simplicity in education and research. He was a master at using acronyms to simplify long and often "high-falutin" words and phrases. Examples include CHAM, PHOENICS, GENMIX, SIMPLE, SIMPLER, SIMPLEX and many others. This practice is now commonplace worldwide. On a personal note, nothing exemplified Brian's principle of simplicity more than the experiment he asked me to perform on Karman vortices. DBS' idea for the was so simple we termed it a "kitchen-sink experiment." I believe the experimental setup cost less than 20 British pounds and was completed in less than two weeks. I was pleasantly surprised that our paper on the results was accepted for publication in the prestigious Journal of Fluid Mechanics without reservation, and the editor accepted an offer to serve as my PhD external examiner.

Prof Spalding taught me the importance of organization, preparation and seeking alternative routes when one path is seemingly failing. DBS was an extremely busy man, given the demands on his time worldwide. Therefore, I learned to maximize any opportunity to meet with him. I would always consider alternative approaches to my primary research assignments. When the opportunity later came to meet with him, I would have prepared well-organized reports on all my exploits before highlighting the challenges. He was always incredibly thoughtful, helpful, unsparing in the amount of time and advice he was prepared to offer. He would often spread my computer papers on the carpet in his office and quickly

identify the sources of any problems. I realized that DBS appreciated my respect for his busy schedule through my preparation and organization. I was fortunate to be associated with many publications and papers from his research group (Computational Fluid Dynamics Unit) during my graduate study. The reports included the first PHOENICS Demonstration Report and the first PhD Thesis produced entirely with PHOENICS.

Prof Spalding made me appreciate the multi-disciplinary nature of most real-life problems, and how CFD could readily be adapted to solve them. I participated in research projects and published joint papers with DBS on topics as diverse as turbulence modelling, multi-phase flow, heat and mass transfer, fire propagation, wall function and others. This early multi-disciplinary training from DBS played a major role in my career. For instance, on joining Massachusetts Institute of Technology (MIT) research faculty in 1986, I had to apply CFD to a variety of materials-processing operations ranging from ferrous to electronic materials. The research resulted in multiple inventions and publication of books and journal papers in the field. I later extended this multidisciplinary approach to the integration of CFD with imaging for biomedical applications ranging from human cardiovascular to respiratory systems in collaboration with major medical institutions in the USA, including Harvard Medical School and University of California Los Angeles (UCLA). I owe DBS a big Thank You for all these achievements.

The literary annals of CFD, Combustion, Turbulence, Heat Transfer and others in the world bear inerasable wisdom, knowledge, and scholarship imprints of the icon of Prof Spalding. He was an arduous, honest, and indefatigable scholar of unparalleled eminence who led by example and produced hundreds of stars in his field to carry on the mission. Prof Spalding was an exceptional visionary. His dream of making CFD a tool for engineering akin to a microscope for experiments has been realized. CFD is a vital tool in fields as diverse as aerospace, automotive, materials, mechanical, biomedical engineering, weather forecasting and many others, thanks largely to DBS.

As a scholar Prof Spalding exhibited rare qualities. He had an unprecedented climb on the rungs of the ladder of success to the peak of academic achievement in record time. No wonder he won the admiration of his peers and students with his incredible ability to handle prolonged scholarly pursuits. He was sought after across the world and held in high esteem at nearly all top institutions. When I applied for the Research Faculty position at MIT, my adviser Prof Julian Szekely (Late) confirmed that Prof Spalding's reference was all he needed to offer me the

position. When DBS visited MIT a few years later, Prof Szekely thanked DBS for sending me his way and asked for more. DBS replied tongue-in-cheek, “Johnson is enough for now. We need them in England too.”

We salute Prof Spalding for his excellent service to university, community, and the world, for his impeccable academic credentials, enormous contribution to research and teaching, outstanding role in the application of science and technology to the solution of societal problems, and above all his unsurpassed humility. We are proud to salute a great man imbued with the spirit of self-sacrifice, which he personified. His dynamic and meteoric personality influenced any who knew him well. I never met a man with a heartier smile. His approach to his associates was direct, simple, and sincere and in his whole make-up, there was not the slightest shred of selfishness. Prof Spalding was a pioneer scholar who provided intellectual leadership. We celebrate the accomplishments of this incredible man whose trademark was simplicity and humility despite remarkable achievements. The valuable services he rendered to humanity and his commitment to excellence will endure.

I learned from DBS that success is the fruit of labour not of wishful thinking. Therefore, we must emulate him in applying ourselves to nobler and greater tasks to climb the ladder of success. I make bold to say that several of our present generation of scholars and researchers would find themselves hard pressed to demonstrate the same capacity for mental discipline. It is not necessary for me to carve a legendary figure of this icon. His work and actions speak for themselves. My firm belief is that he made an indelible mark that will be tough to equal for generations to come. I am absolutely convinced that Prof Spalding was essentially a man of incomparable and unsurpassable intellectual intelligence and curiosity. We owe it to the academic profession to honour, preserve, and promote the achievements of this legendary scholar.

Prof Spalding's life was a blessing and his memory a treasure. He was loved and adored beyond words and missed beyond compare. To leave this world a better place than he found it would be, perhaps, the greatest epitaph to his memory. DBS was proof that being a brilliant scholar, an unassuming and kindly person and living life to the full do not need to be mutually exclusive because he personified them all.

The best tribute we can pay to Prof Spalding is to emulate his great example. The best homage we can pay to his indefatigable spirit is to tread the path he exemplified. He demonstrated a vivid example of self-application and self-

sacrifice for scholarship for which he will be long cherished and remembered. His legacy will remain a constant source of inspiration to the rising hosts of young men and women who want to devote their talents and energies to the pursuit of knowledge and serve humanity.

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Snapshots of Brian: Nikos Markatos

Very pleasant (always) moments at Brian's house during birthday parties and on other occasions involving Imperial College and CHAM Researchers and staff.



Dec 1986: Milorad Dzodzo, An Academic Visitor, Brian Spalding, Denis Asimakopoulos, Nikos Markatos

A Contribution in Celebration of DBS's 100th 'Birthday': Marcel Escudier

My first encounter with Brian was in October 1960 when he taught thermodynamics to first year mechanical engineering undergraduates. My recollection is of a sandy haired young man (he was then 37 years old) wearing a grey three-piece suit. The second encounter was in May 1963 when I was asked to present the results of my final-year project to Brian's Thermofluids Research Group. The following academic year Brian was my supervisor on a postgraduate (DIC) project. This was an enjoyable year, not least because Brian was using the results of my project calculations in his postgraduate lectures, which I attended, and we met far more often than he did with most of his research students. Consequently, in October 1964, when I started my PhD under his supervision, we knew each other pretty well and had already developed a very good working relationship.

At some stage in my second PhD year Brian informed me that every well-rounded PhD had to include an experimental aspect. I've heard from others he implied this was a University of London requirement, but I suspect it wasn't. He 'suggested' using hot-wire anemometry to investigate a turbulent boundary layer subjected to an adverse pressure gradient sufficiently severe to cause separation. The pressure gradient was produced by a

massive step downstream. In addition, a region of blowing (transpiration) was introduced upstream. Anyone who has looked at such a flow will realise it was a bit of a challenge.

Perhaps surprisingly, I was the first to use hot-wire anemometry in the Department (according to someone, it was the problems I encountered, and subsequently detailed in my PhD thesis, that led Jim Whitelaw to develop the laser Doppler anemometer with Franz Durst). A major problem in the recirculating wind tunnel I used was dust build-up on the heated wires causing major calibration drift. When I went to see Brian about this he just said, “flypapers”, expecting me to collect the dust by installing flypapers ahead of the working section. I didn't find this to be the most helpful advice so ignored it!

Somewhere in the mid-1960s Brian was asked to review a journal paper submitted by a well-respected academic from Southampton University to the Proceedings of the IMechE. It concerned hot-wire anemometry about which Brian said he knew very little and so asked me to do the review, with an explanation to the journal editor saying that he felt I was an appropriate choice as being “suitably imbued with disrespect for his elders”. I have no idea where he got that idea from but I think it revealed that Brian was not lacking in a sense of humour. Another example of his humour was after reading through a draft of my PhD thesis, in which I had referred to this case, that case, and so on, he wrote “Where on earth are you going with all these cases?” A further example came several years later when I took him for dinner in London. During our conversation I asked if he cooked. The rather terse reply was “I am a consumer”.

Personally, I found Brian very easy to work with, and not in the least condescending or intimidating. The latter was probably due to my naivety and unawareness of him as a major international figure in our community. I should have been alerted to this by the number of high-profile visitors to the Thermofluids Group, including Bill Kays and Bill Reynolds from Stanford, Frank Schmidt from Penn State, Roger Eichhorn from Kentucky, and Samson Kutateladze and Aleksander Leont'ev from Novosibirsk. I recall other research students being incredibly nervous about meeting with Brian. One, (no names), would empty his pockets beforehand of anything, such as keys and coins, that might cause a distracting noise during their meeting. Arranging such a meeting to discuss day-to-day progress was tricky if you followed the official procedure of arranging it through his secretary, Marjorie Steele. I discovered the trick was to knock on his office door after she had left for the day: he would always see me.

Kutateladze and Leont'ev had written a monograph with the title *Turbulent Boundary Layers in Compressible Gases* which Brian had translated from Russian into English. A remarkable feature of the book are Brian's numerous comments as translator's footnotes which reveal something of his thinking not to mention adding considerably to its length (some footnotes extend to more than a page). It was shortly after publication of the English version that these eminent engineers came to visit. A meeting was arranged at which each of Brian's research students (including Suhas Patankar) was asked to say what they were working on. Brian acted as translator. After every presentation, Kutateladze said they had already done whatever it was. Towards the end, when it came to my turn, I started by saying “there's no point in saying anything, they'll have done it already.” With a straight face, Brian translated. There was a shout in Russian from Kutateladze which Brian translated into English as “sacrilege” to laughter all round.

I fell out with Brian on only one occasion when he said I should leave out of a paper I had written a lengthy appendix giving all the details of the analysis I had been doing on a drag-law correlation. I was so angry at this suggestion I actually threw a pencil across his office. He didn't react and the incident was never mentioned.

In spite of his legendary insight Brian wasn't infallible. On one occasion he asked me to read the draft of a paper he had written. He showed that the quantity $\partial\tau/\partial u|_{\infty}$, the gradient of the total shear stress τ with respect to the streamwise velocity u , at the edge δ of a shear layer is equal to the entrainment rate, an interesting result I've not encountered anywhere else. Having evaluated $\partial\tau/\partial u$ as the quotient of the spatial gradients of τ and u , Brian proceeded to approximate $\tau(y)$ and $u(y)$, differentiate both and take the ratio, as y approached δ , as the entrainment rate. After reading the paper, I pointed out that both gradients were identically zero at the edge of the shear layer but became non zero when approximate expressions were adopted for the spatial gradients of τ and u . I only found out during the Stanford Conference in 1968 that he agreed with my assessment that this made no sense and so binned the paper.

On another occasion, late one Friday afternoon, he gave me a manuscript of a monograph he was working on, about 200 handwritten foolscap pages (another reminder of how long ago this was), and said he would like my comments by Monday morning. I duly obliged with page after page of ‘corrections’ and suggested modifications in red ink, which he largely accepted. So far as I know the monograph was never published.

In December 1964 Brian introduced his entrainment-based Unified Theory, an integral method, the limitations of which became very clear as was the fact that the future lay in turbulence modelling, not to mention DNS. My infinitesimal contribution, to turbulence modelling, was to extract mixing-length distributions from experimental data. The only evidence for this was a technical note given the designation TWF/TN/1 which I wrote in 1965 and which, somewhat bizarrely, was referenced in an edition of Schlichting's book.

Two other PhD students working with Brian on Unified Theory were C L V Jayatilake and Earl Baker. We shared an office with Peter Duffield, another of Brian's students, and Mark Lee who worked with Sir Owen Saunders. Other contemporaries included Micha Wolfshtein, Fred Chi (for those who remember him, he was S W Chi while at Imperial), David Gosman, Sivanandam Sivasegaram, Sam Pun, Aki Runchal, and, of course, Suhas Patankar.

To conclude, after finishing my PhD I went to MIT, found it very much to my taste, and culturally very similar to Imperial. It was only after I left MIT that I realised it wasn't like that everywhere. That made me even more appreciative of Brian and Imperial, and what a privilege it had been to work so closely with him.

Marcel Escudier, 25th October, 2022

To Honour the Memory of Professor Spalding: Jasmine Li, CHAMPION



Jasmine Li, Professor Spalding, Mr Fan 2004

Our company, CHAMPION Engineering Technology Co Ltd is honoured to have cooperated with the distinguished Professor Spalding and his CHAM Company for more than 20 years. We deeply feel the respectable personality and honourable academic achievements as well as standing of Professor Spalding. The photo is a snapshot with Professor Spalding at the 2004 PHOENICS Global User Conference in Melbourne, Australia.

A Contribution: Guilherme A. Lima da Silva

D B Spalding's early works were crucial to the development of my PhD thesis "Heat and Mass Transfer

in Two-Phase Flow Around Airfoils Equipped with Aeronautical Anti-Icing Systems." Although not directly related to combustion or computational fluid dynamics, his work on heat and mass transfer proved invaluable.

My introduction to PHOENICS and D B Spalding's work came from Prof Clemente Greco at the University of Sao Paulo in Brazil, where we discussed droplet evaporation and combustion. Prof Euryale Zerbini and Marcos Pimenta also introduced me to Spalding's works on heat and mass transfer. During my MSc and PhD, I relied heavily on "Convective Heat Transfer" by Kays and Crawford, which also builds upon Spalding's theories.

What caught my attention was Spalding's rigorous and accurate approach to mass transfer, particularly the interaction between mass and heat transfer coupling. For anti-ice systems, evaporation plays a significant role in determining surface temperature, with dry areas experiencing normal convection and wet areas subjected to evaporative cooling effects. The influence of evaporation on thermal boundary layer thickness and heat transfer coefficient is also noteworthy. Prof Zerbini pointed out the incredible and ingenious calculation of the coupled effect, which worked wonders for my research. Spalding's "Convective Mass Transfer: An Introduction" from 1963 is still considered the bible for understanding underlying physical phenomena, with the double film approach being exceptionally well explained and implemented. Even current computational fluid dynamics codes are not as accurate as Spalding's work.

Spalding & Smith's 1958 work, "Heat Transfer in a Laminar Boundary Layer with Constant Fluid Properties and Constant Wall Temperature," remains a reference for calculating the heat transfer coefficient over an airfoil with ice formation. It is a part of several classic icing codes, including ONERA 2D by D Guffond, ONERA, France.

I relied on the TEXTAN code during my research, which was developed from STAN5, a code that traces its origins back to the first code developed by Patankar and Spalding, GEMNIX. I also utilized Tuncer Cebeci's BLP2C code, which, despite being more modern and compressible, still employs the finite difference implementation from Spalding's early codes. The mixture length turbulence model used is also similar to the one Spalding used in his early models.

Despite the references not being modern or directly related to computational fluid dynamics, Spalding's classical works were fundamental in creating a realistic and accurate heat and mass transfer model over an airfoil with thermal anti-ice systems operating under

atmospheric icing conditions. I also used superposition methods, a topic Spalding explored in his early works when computing power was not as robust as it is today. He considered the boundary layer history effect caused by the streamwise temperature gradient on the surface, as described in his work from 1958, "Heat Transfer from Surfaces of Non-Uniform Temperature". The following are the works cited in this contribution:

Smith AG, Spalding DB Heat Transfer in a Laminar Boundary Layer with Constant Fluid Properties & Constant Wall Temperature. J Royal Aeronautical Society, Vol. 62, pp 60-64, 1958.

Spalding, DB Heat Transfer from Surfaces of Non-Uniform Temperature. J of Fluid Mechanics, No. 4, pp 22-32, 1958.

Spalding, DB Convective Mass Transfer: An Introduction. New York: McGraw-Hill, 1963.

The Ph.D. thesis can be accessed here:

<https://teses.usp.br/teses/disponiveis/3/3150/tde-27032009-082825/en.php>;

My Google Scholar: <https://scholar.google.com.br/citations?user=WcDwizIAAAJ&hl=en>

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Memories of Brian Spalding: Said Elghobashi

Said sent copy letters relating to Brian's becoming a member of the Royal Society in 1983 and also the dinner to mark his "Retirement" in 1988.

He also sent the following which sums up Brian's desire to ensure that all English was correctly used:

"January 19, 1988

It is well known that Prof. Spalding is a prolific writer of technical and nontechnical subjects. His writings are characterized by a certain and rare elegance.

He never tolerated bad writing from his students or associates. I remember as a student at I.C. receiving his manual that contained not only a list of frequently encountered grammatical errors and how to avoid them, but also a guide on the art of technical writing.

His insistence on good writing was made indirectly very clear to me one day in 1975 on a flight from London to Paris. I was sitting next to Prof. Spalding and happened to notice that he was marking the errors in the London Times."

A. Elghobashi

Snapshots of Brian: Professor W P Jones



In 2014 Professor W P Jones of Imperial College was instrumental in Brian receiving an Honorary Degree from IC. The Ceremony took place at the Royal Albert Hall and the above photo shows Brian, in his finery, with Bill Jones. Bill also arranged Brian's 90th Birthday Celebration at IC in 2013 and his Memorial Day which took place on April 20 2018. For all you did Bill: Many Thanks.

A Tribute to Dudley Brian Spalding FRS, FREng, 1923- 2016: Eugene Levich

This remarkable man and distinguished British scientist Professor Dudley Brian Spalding FRS/FREng played a major and quite dramatic role in the very existence, up to now, of this particular Levich family. The main cause of the drama was the late Professor Veniamin/Benjamin Levich a, world renowned Soviet (later US/Israel) scientist who, in the late 1940's, was involved in building a Soviet nuclear bomb, in a project parallel to one led by Zeldovich and Chariton building the genuine Soviet nuclear bomb.

The Levich bomb was based on materials stolen from the Manhattan Nuclear Centre and the British Centre in Canada. It was first tested in the former USSR in 1949 on the personal order of Beria, dreaded head of NKVD and commissar of nuclear bomb development. Beria is known to have said to Stalin: "If this bomb worked for America it should work for us. We cannot risk a failure with our original design, even if it is better than American".

Levich was deeply shocked by the explosion record and, the same year, was allowed to resign from his top-secret position on the grounds of physical and mental ill health. He was spared from further development of the hydrogen bomb, although materials from the notorious nuclear spy Klaus Emil Julius Fuchs passed under his scrutiny. Also, Kurchatov, the most powerful boss of the nuclear project advised the NKVD to leave Levich alone due to the invaluable contributions he had made and would make. Levich was reassigned to head a team developing nuclear reactors for power stations. He was then fired and spent

a few terrible years at the end of Stalin's rule. Stalin, by that time, was quite insane and under "influence" of vodka and one of his most brutal butchers Nikita Khrushchev who, by an irony of history, is remembered by many as the liberator from Stalin's repressions. Until 1967 Levich led an illustrious, peaceful, scientific career, was elected a member of the Russian Academy of sciences and head of large theoretical and applied mechanics departments in two top Moscow institutions. There he wrote his famous book "PhysicoChemical Hydro dynamics (PCH) which, 1962, was translated into English. Almost immediately, Levich became a celebrity in the fields of fluid mechanics, PCH flows and electrochemistry.

He was still considered unreliable by the NKVD and, despite many invitations from the US National Academy, British Royal Society, Vatican Academy, was allowed by the KGB to travel abroad only once to the US and once to England surrounded by English-speaking KGB agents he never saw before. Nevertheless, Brian managed to meet Ben and even "kidnap him" to his London home while KGB operatives were shopping for female lingerie and such merchandise. Similarly, on his visit to the National Academy in Washington, he met Oppenheimer face-to-face (except for FBI hidden cameras) when two bulky KGB ladies were tempted by a CIA lady to shop for lingerie.

At the end of 1971 Levich declared publicly that, as a Jew, he could no longer tolerate the post Khrushchev/Brezhnev antisemitism (the official and obligatory policy of the Communist Party in all public life, education and media) and wished to emigrate to Israel. He had signed no secrecy agreement or security clearance obligation; he was not involved in secret or double application work since 1949; there was no reason not to allow him and his family to leave the USSR. Hell opened up. In 1978, under unprecedented pressure from the international science and technology community, from the USA, England, France, Sweden, Norway, Australia, etc Levich and his gravely sick wife Tanya were allowed to leave for Vienna.



They were met by a top medical group and the indomitable Brian Spalding. An incredible international

campaign involving dozens of Nobel Laureates, thousands of scientists, and hundreds of public figures in the West forced the internally decaying "Evil Empire" to let Levich go. Brian single-handedly started this campaign, made it grow into a huge international issue and won. He also succeeded in saving me, Eugene Levich, from a Soviet Labour camp in the far Eastern Siberian Arctic after just a year and a half of a moderately unpleasant experience.

As Brian was inexorable in creating the best and first commercial Computational Fluid Dynamics software that is different from all others, so he was inexorable about doing right in all his enterprises. Blessed be his memory and his lasting achievements.

I met Brian in Spring 1972 in Moscow. I had heard that such a man existed in foggy Albion many times from my father Benjamin Levich who told me that Brian is an outstanding British scientist who works in the field of fluid flows combined with PCH, an area of science that combines flows of fluids with admixtures that, while flowing with the fluids, interact in the chemical and nuclear reactions. Much of what I know I learned from my father who was not very keen on wasting his time on my education, and later in generous conversations that I have been privileged to have with Brian, in the UK and the US.

Brian had a mind endowed with quantum duality. He would be dwelling on current science applications to technology when, with no effort, he switched his mind to the needs of tomorrow's science and technology. He was tough in distinguishing between researchers spending time and resources on esoteric hypothesizing with no clear path to realizable goals, and those with clear ideas on the path to practical applications with impact. I remember when I mentioned to him names of scientists who, I believed, were making valuable contributions in various fields of knowledge, he would listen attentively but when I finished confront me with a one sentence question: "Eugene, it is interesting, but what has this person done specifically that is significant now and may be significant tomorrow?" I would stop and consider whether what the person did was of lasting significance to stay tomorrow, or it was a spark without fire.

This was, I would have loved saying "is" the credo of Brian. He loved jogging and ran while looking into the future. He was practical and methodical on one hand, and romantic on the other. Colleen King, his wife, and indispensable help, Colleen who played a big role in much of his life and achievements, and to whom we feel sincere affection, noted in her recollections that one aspect of his character was entirely Newtonian, determined by placing

impenetrable barriers between What is Right and What is Wrong; what must be done and what not, in science, in politics, in relations. As all mortals he could not know or decide to his satisfaction always and had doubts from time to time. Then he would candidly admit that he did not make decisions, express opinions or take sides at this time. His decision must mature and collapse, like the wave function, to certainty. Brian was a prince of a man in life. However, enough of sentimental recollections that, if not cut short, would take us away from Brian's professional achievements.

What did Brian do in science and technology, specifically, as he used to ask me? I am sure his school and those working in CHAM know more than I by far concerning the details. However, there is a dimension to his scientific and intellectual legacy beyond particular scientific papers, lectures and books - valuable as they are. This other dimension in my humble view is CHAM. Its combination of applied science, integrated packages of software algorithms (general, universal and technically transparent for users) make CHAM, and this is greatly important, a world leader in the field. This is my personal opinion as a theoretical physicist by profession with lifetime passion to cosmology, but also a high-tech entrepreneur in the past. The most valuable aspect of CHAM is the quality of personnel working in, and for, the Company. Brian trained the best of the best students in the field, in Imperial College to optimise the science/technology/software algorithms integrated into the PHOENICS package.

I would like to make an historical reference. In the 1870's the great English scientist and engineer, the first Professor of Engineering in Europe, Osborne Reynolds understood the amazing property of the Navier-Stokes equation that we call the NSE self-similarity and introduced the famous Reynolds dimensionless number: $Re = L \cdot v/\nu$. Everyone knows L stands for size, v is typical fluid velocity, ν is fluid viscosity. This was an amazing observation that allowed small model vessels and aircraft to be built, tested in small wind tunnels and later built full size by scaling up, while fixing $Re = const$. When ready the actual vessels and aircraft could be tested in large channels and wind tunnels. Were it not for the genius of Reynolds modern civilization, whether one likes it or not, would have not existed as it now does. Some would say that were it not Reynolds some other smart guy would have done it. But history attests that Osborne Reynolds did it. Some say that if Einstein had not paved the way to the nuclear bomb via his $E = mc^2$ then someone else would have. But Einstein understood it specifically, and Heisenberg had not, so we live in a world

of nuclear bombs but also nuclear power stations.

Reynolds did not rest on his laurels and understood that the NSE cannot be solved if flows are turbulent, and that statistical description is the way to simplify the NSE by creating a semi-phenomenological equation separating mean velocity of flow and fluctuating randomly. This would be more tractable while, hopefully, not losing vital information when solved by comparison with what NSE would furnish. This position was advanced by Boussinesq and a new field of science & technology was born that we call "Modelling of turbulent flows". I would emphasize that it is not just mathematical manipulation that led to Reynolds equation and Boussinesq approximation. In the first place stood profound scientific and intellectual intuition that told them what is right and what is wrong, when the simplifications would work and when they would not. In accordance with Brian's position these achieved while others hypothesized, and philosophized.

The Franklin Medal

Brian won many awards during his long and distinguished career. One was the Franklin Medal received in Philadelphia in 2010. Prior to the medal ceremony Brian lectured at Villanova, the University of his Sponsor for the Medal, Professor Jerry Jones with whom he is pictured in the bottom photo. In the top, from L-R, Steven Beale, Andrew Pollard, Brian, Aki Runchal and the late Malcolm Andrews.



Remembering late Prof D B Spalding on his 100th Birthday: Anil W. Date, PhD, FNAE, Emeritus Professor, IIT Bombay

1 IC Years 1969-1973

My association with Prof Spalding began with a handwritten letter I sent to him in May, 1968 from UMIST, Manchester seeking admission to the PhD program at IC with financial support. I received a reply from him advising to await communication from then Admissions Tutor, Prof Launder. Yes, by end-of-September-1968, I did receive a letter advising to join the college. I moved to London in late October and completed PhD registration

formalities at IC. Prof Spalding who was the principal member of my thesis-committee not only gave excellent advice on all technical matters of CFD but he took the initiative to provide me with an education. Two examples: (i) In 1969, he advised me to gain practical experience and enabled me to visit the Swedish Atomic Energy Research Lab. I spent 6 weeks there experimenting and wrote a report [Date A. W., "Some Measurements in Tubes Containing Twisted-Tape Swirl Generators", AE-RL-1157, AB Atomenergi, Studsvik, Sweden (1969)]. On the return journey, I hitch-hiked visiting major University Campuses in Lund, Oslo, Gothenburg and Amsterdam before taking the return Ferry at Rotterdam. A very unique experience. (ii) In 1972, he found financial support from IC-bursary to enable me to attend a conference in the US where my paper was accepted [Date A W and Singham J R, "Numerical Prediction of Friction and Heat Transfer Characteristics of Fully-Developed Flow in Tubes Containing Twisted Tapes", AIChE ASME 13th National Heat Transfer Conference, Colorado, USA. Paper No: 72-HT-17]. The objective was to gain experience in paper presentation at a conference. Prof Launder was in the audience who gave favourable feedback about my performance which was reflected in Prof Spalding's recommendation letter to IIT Bombay which earned me direct appointment as Asst Professor.

Incidentally, the bursary was large enough to buy me a London-NY-back NUS flight ticket as well as a 21-day open Greyhound bus ticket. I made full use of this to travel coast-to-coast in America including a visit to Denver-conference venue, Niagara Falls and the Statue of Liberty and the Empire-State Bldg.

2 1984-1986



I certify that
Kartikeya Date
is a suitable student
to be admitted to
Imperial College.
B. Spalding 20.6.86

Fig 1: (top) Anil with Kartikeya (age 6) at IC, Exhibition Rd (1984) (bottom) Prof Spalding's Recommendation at my home in IIT (1986)

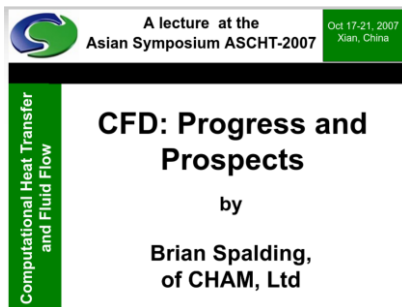
In 1986, Prof Spalding was invited to lecture at a "Heat Exchanger Design" course organised by Tata Research, Design and Development Center (TRDDC) in Pune, a city approx 150 km from Bombay. I had kept track of his arrival and departure details and knew that he had to catch his return flight from Bombay airport around 6pm. I therefore asked him if he could come to IIT Bombay for a lecture before catching his flight. He declined the lecture but agreed to visit my home in IIT. He travelled by car from Pune and reached our home at around noon. My wife and mother had laid the table for Lunch with the family. Fork, knife and spoon surrounded Prof Spalding's plate (like in a restaurant). To our surprise, he asked "Why am I being singled out?" and started eating with fingers-and-all like it is common in Indian households!!!

In 1984, I spent 3 months at Cornell Univ as a visiting Scientist. My wife and son also joined me. Our Bom-NY Air-India flight allowed for a stopover in London and we took advantage of the provision to do sight-seeing in Central London. Fig 1 (top) photo is taken at the entrance to IC. When shown to Prof Spalding at my home in 1986 by my son, he promptly flipped the photo and wrote a message (Fig 1 (bottom)). We were absolutely amazed at the correct spelling of the difficult-to-pronounce name Kartikeya!!!! Professor's handwriting is a treasured possession. Well, much as he prompted, Kartikeya took to Architecture and after UG degree from Bombay Univ did MS in ASU and followed up with a PhD from UC Berkeley. He then followed his Professor and took up a post-doc position at Technion-Israel Institute of Technology, Haifa.

3 Xian, China, 2007

In 2007, I attended the 1st Asian Symposium on Computational Heat Transfer and Fluid Flow, Xian, China where Prof Spalding delivered the Key-note Lecture on the first morning (Fig 2-top). The lecture was unique in that there were hardly any equations - only concepts. While I could follow and appreciate the *progress* part of the lecture, I found the *Prospects* part quite daunting.

In the first session after the morning tea-break, I was scheduled to present the paper (ASCHT07-X02 by Nandi and Date) titled *Simulation of Flows with Interfaces* in which the SIMPLE-collocated algorithm using *smoothing pressure correction* described in my book [*Introduction to Computational Fluid Dynamics, Cambridge Univ Press, (2005)*] was extended to prediction of unsteady interfacial flows of two immiscible incompressible fluids.



**Fig 2: (top): Keynote Lecture
(Bottom): Technical Discussion Post-Lunch in Hotel Lobby**

As I began my presentation, I found Prof Spalding sitting in the front row! It did comfort me because the two of us were the only ones with an IC connection. Later, Prof Spalding found time after lunch to further discuss my approach (Fig 2-bottom). At this meeting, he also asked me "what impression has the population balance approach" advocated by him in his lecture made on me. I had to confess that it was too new and alien to my way of thinking about what characterises a continuum fluid.

The next morning, we met again at breakfast (where Madam Colleen was present) and then parted company.

4 Rutgers - 2015

In 2013, at the 13th ASME Heat Transfer Conference in Minneapolis, Prof Spalding was felicitated on his 90th Birthday. Although I had two accepted papers (HT2013-17661 and HT2013-17662), I could not attend the conference. On that occasion, I had sent a written message; here are some extracts:

"You are of course world famous for the pioneering contributions in both academic and Industrial CFD. But, I have found your very early contribution of ' Reynolds Flow Model -Reynolds Flux Hypothesis and the Spalding number B' in the book ' Convective Mass Transfer' (1963) very useful in a variety of applications involving Heat and Mass Transfer.

Yes, I have benefited and been enabled to lead a satisfying professional life -thanks to my 4-year association with IC-Heat Transfer Section and the rich writings of D B Spalding. With respectful regards and, as a cricket fan, am certain that you will cross 100.... " But, alas, it was not to be.



**Fig 3: (Top) 3D Printed Template of SIMPLE-Staggered
(Middle) Presentation of Models to Profs Spalding & Patankar
(Bottom) With Profs G de Vahl-Davis, P Vanka & A Runchal**

When the 2015 CHT symposium was announced where both Profs Spalding and Patankar were to be felicitated, I submitted a paper (CHT-15-180) which was accepted. For over 30 years since its publication, (Patankar S V & Spalding D B, IJHMT, vol 15, pp1787-1806, 1972) the world Heat Transfer community benefited from use of the SIMPLE algorithm. As an expression of our respect, my students built a Table-top model using a 3D-printer available in our Tinkerer's Lab. The model (Fig 3 top) depicts the famous staggered grid layout of partially overlapping control volumes and use of lettered designation of node P and its neighbours N, S, E, W. It was my honour to present a model each (Fig 3 middle) to Profs Spalding and Patankar at an informal pre-lunch gathering where other former IC students and co-workers (Fig 3 bottom) of both authors of SIMPLE were present.

5 Closure

1. This write-up is prepared in response to an email from Colleen Spalding at CHAM requesting an "eclectic collection of memories" of Prof Spalding because "January 9 2023 is Brian's 100th Birthday and CHAM is dedicating the Winter Newsletter to his memory."

2. After completing my PhD followed by a 9-month stint as a PDF at IC, I moved to India in 1973 and have lived

and worked in IIT Bombay. However, I have been fortunate to have had occasions to meet Prof Spalding briefly during conferences.

3. I would remain eternally grateful to Prof Spalding for (i) the rich educational experience at IC, (ii) visiting our home in 1986 and writing an inspiring message for our son, and (iii) for approvingly reviewing pre-publication copy of my CFD book in 2004 and making suggestions via 4 emails for improving the quality of the Text.

4. I have read previous accounts of Prof Spalding's multi-faceted personality embedded in Science, Industrial Consulting, Poetry and Humanities. A 2021 Springer publication: *50 years of CFD in engineering sciences: a commemorative volume in memory of D. Brian Spalding* edited by Prof Akshai Runchal sums it all up. So, when I read about his passing away in Nov, 2016 at the age of 93, I said to myself "century of a distinguished life" must be the only accomplishment Prof Spalding missed.

5. I close by wishing the CHAM's Winter Newsletter every success.

<https://www.me.iitb.ac.in/?q=honorary-faculty-members>

Professor Spalding: Jagu Mistry

I was privileged to have been associated with Professor Spalding. He was an amazingly sharp scientist and a visionary. He changed the whole field of computational fluid dynamics and heat transfer. I remember meetings with him and, before I could finish explaining my problem, he had an answer. He was very personable. Pushpa and I felt so good when he visited us in our apartment in Canada in 1980 just to see our first one year old son. I feel so sad he is not with us anymore. I would have liked to meet him one more time.

The world needs more people like him. Where ever you are Professor Spalding, you will always remain in our memory and heart.

Adios Professor. I often wonder if we will cross our paths one day in the life after death.

Your student Jagu Mistry

Brian and Russia

Brian loved Russia - country, people, music and language (which he spoke well enough to lecture in it - if required). No memory would be complete without some record of time spent in St Petersburg (attending Summer Schools arranged by Sasha Leontiev or Global Energy Meetings) or Moscow (working with his Research Team (Nikolai Pavitsky and Alexey Ginevsky) and where he was taken ill in 2016. His relationship with Russia palled during the time he worked to obtain freedom for the Levich family but his affection for all things Russian never dwindled.



St Petersburg 2007: Professor Leontiev's Summer School



Brian loved the works of Pushkin. We visited the area from whence Pushkin came with Sergei Sapozhnikov and Vladimir Mitiakov. It was a journey of many memories.



Brian and Pushkin

Cologne: Brian's last Lecture October 2016



The Age of Brian: 5 years in Providence: Herve Miler

“Every story has a beginning, middle and an end. But not necessarily in that order”. It eludes me when my own story with Brian will end, for what I thought buried deep in the memory and lost forever has just surfaced when I was asked to give my contribution to his centenary. Whilst I cannot know for sure the ending, there is no doubt it started on a Wednesday morning in late November 1995. It was my job interview in Brian’s office at CHAM’s headquarters in Wimbledon. In fact, if someone wished to make a TV series of what it was like to work with Brian, Episode 1 of Season 1 could open up on this freshly-graduated, Frenchman, in an oversized cheap suit, hands crossed, sitting his office, impressed and shy. For me, “D B Spalding” was just a name I had come across many times at the late Rhone-Poulenc Research Centre in Lyon. There, I had discovered and “embraced” CFD whilst using PHOENICS to model two-phase flow in a reactor. Popular names like “k-ε”, “SIMPLE”, “staggered-grid”, “IPSA”, the Unified Conservation Equation were systematically associated with “D B Spalding”; and will remain so, just like the Requiem, Don Giovanni, and The Marriage of Figaro will remain with Mozart. Therefore, seeing Brian in real life was rather an intimidating experience.

What impressed me that morning was his very respectful, yet attentive welcome for a complete rookie. Even more remarkably was his striking enthusiasm and the profound sincerity and total absence of condescension that drove him on during our long conversation about CFD. This was especially so when he eventually sat beside me to present with unbridled passion his multi-fluid turbulence model. He then turned to me and asked what I thought. I felt I had to answer with the same honesty: “Well, Professor, I am sorry, but I doubt I have understood everything; but for sure; it looks new and nice”. My answer clearly didn’t deter him, because he said he would gladly hire me, and soon after, he took me for a little tour of CHAM, where I completed my interview with Mike Malin, Head of Technical Support, and with whom I would work happily for many years. This is how I became “Harvey” or “HM”, the very first Frenchman ever to work in Brian’s “den” in Wimbledon.

There were about 40 of us in CHAM and many, like me, were non-natives (Chinese, Russians, Greeks, etc.) - Brian’s attraction went well beyond continents. I soon realised that Brian seemed to know everything and his talents had no boundaries: not only turbulence, heat & mass transfer, multiphase flow, radiation, numerical

methods, solvers; but also English, Russian, German and Poetry. As a result, revolutionary visions, cross-field ideas, unique tricks for solving engineering problems buzzed everywhere. As a CHAM engineer, you had to be versatile, working on engineering consultancy, software development, user support, and sometimes sales. In all cases, you had to write “well” in English, regardless of your mother tongue. It was advised you become familiar with Brian’s, sadly little-known, publication: “The writing of technical reports”. Of course, like in any organisation there were the “top guns” (Mike, John H, John L, etc), and believe me, those people could climb fearlessly up the trickiest CFD summits, however icy; and of course, reach any “CFDmandjaro”... running. To me, they were in their own way, the All Blacks of CFD, whilst I was just a hometown rugby player. For that experience, to Brian and all of them, I shall be eternally grateful: they let me play, they let me touch the ball, and sometimes, they even allowed me to score. It has been a privilege to work alongside them.

Brian always showed an appetite for novelty and by default, an interest in new people. He would welcome any ideas or suggestions, provided well minded, and as far as possible, what he deemed “novel”. He stressed this in my first ever task allocation, where I was asked to acquaint myself of the ways in which CHAM worked, but *“do not suppose that those ways are unchangeable. In many respects, they should be changed; so you should feel free to make suggestions”*. I cannot think of any other place, where such an invitation would be put in writing like this, or where visions and strategies were unveiled in the way they were at CHAM. For example, Brian could sometimes use Shakespeare to justify his visions. I can recall him urging us all to use the PHOENICS VR interface, dismissing its initial restriction to cuboid objects, insisting reality didn’t have to be matched too closely, and then quoting and impersonating Snout from Midsummer Night’s Dream: *“Thus have I, Wall, my part discharged so, And, being done, thus Wall away doth go”*. No matter how successful your academic or professional background, when you entered Brian’s circle, you would quickly realise that *“there were more things in Heaven and Earth, than were dreamt of in your philosophy”*.

Another noticeable feature of those times was Brian’s memos, which were often hard to decipher. The reason was less his handwriting, but more he would revolve, unaware, in astronomical heights, and beyond the reach of normal humans. He could see things nobody else could, and do all the others 10 times faster. He too, like “Amadeus” Mozart, was loved by the Gods. Therefore,

Brian did allocate tasks with minimal description and limited explanations. Thinking back, I guess his memos were merely a reflection of his mind: inventive, dazzling and in perpetual motion. As a result, the latest idea would expel the previous one, and so we, as his team had to pursue the path sketched out by Brian and complete the job with its missing pieces.

There was a time when Brian asked me to review his coding of a 2-phase oil-droplet combustion model. This must have been quite early on in my CHAM career, so I guess it could be called Episodes 2 and 3 of Season 1. After reviewing Brian's coding, I queried the interphase mass-transfer rate because it differed from its classical form, which involves the Spalding transfer number, B , no less. Why such a difference? I did not know. The "top guns" didn't know either, and Brian himself couldn't recall; and so my question iterated around the triangle of Brian, Mike and myself without end result. So, I suffered, until mercifully Brian came to my desk, took out his fountain pen, and then sketched some drawings and graphs, before finally jotting down at high speed and before my bewildered eyes, some (still to date) "mystical" equations and Newton-Raphson algorithms to solve for B and the saturation temperature. Clearly, Brian too, sometimes worked in mysterious ways.

When there were no mystifications, and when your prayers were answered, then working with Brian was pure joy, and you felt yourself flying high with the angels. Like when I was assigned to implement in the code the appropriate treatment of the boundary conditions for the (then) new IMMERSOL radiation model. Uncertainty reigned as to which temperature equation (TEM1 or T3) should receive the source terms; but this time, Brian's replied quickly with clear explanations and the bonus of little hand drawings to illustrate his thoughts. Hallelujah!

Such was life in CHAM, with its lot of difficulties, unexpected twists and turns, its inconsolable dramas, and such episodes where you would be rowing low. But it also went with the most exciting stories, unique climaxes, pure brightness and unique wits, and such episodes where you would be flying so high as to feel you were evolving amongst birds. I told you: a proper TV series in itself, with Brian's ideas the reasons for most scenes. Should you work the weekend to check on a long simulation, or to accelerate a project, Brian would come to open the company back door, always with a welcoming smile on his face. Should you be jogging on Wimbledon Common, you could spot him, walking back to his house with his stick, his mind visibly floating amongst beams of light and ideas us mortals couldn't see. Brian's legacy is

immense and unequalled, but I cannot help thinking it would be even larger, if he'd taken the time to complete or to document even more of his ideas.

"Life is what happens when you have planned something else". After 5 years with Brian, life called me back to France to join CETIAT (the technical centre of the HVAC industry) where CFD is strong. After my resignation, I received a very touching and dignifying farewell letter. Brian wrote: *"You have made many excellent contributions while you have been with us; and you can feel confident of a warm welcome whenever your return. Thank you"*. I never returned to CHAM in a professional capacity, but the story with Brian did not end then. I popped in to see him whenever I returned to England, and sometimes we would exchange emails, like when I told him how much I admired some of his lectures, such as: "CFD: Past, present and future" & "CFD: The new oracle" in 2007; and "Benjamin Franklin and CFD" in 2010. These are a perfect reflection of Brian's unique style, mind and vision. The last time I spoke to him in person, though, was in CHAM, in summer 2014, when I introduced my 5-year-old son. This was a quick but nice chat, although I could have done without what would prove to be his very last words to me: *"You have put on weight"*. On this as well, you see, as on so many occasions during his incredible life, I have no doubt: he was indeed entirely correct again.

Herve MILER, CETIAT, Villeurbanne, France

Conclusion

I would like to express my heartfelt gratitude to all who sent articles and photographs for this Newsletter.

They are eclectic – as was the man they remember. They were quite often emotionally difficult to read, or to view, which seems appropriate.

It also seems appropriate that Brian should have the last word via the poetry he so enjoyed composing, sharing with others when he read it aloud, and which was the medium he chose for his only "Autobiography".

I think / hope Brian would have enjoyed this Newsletter. I thank you on his behalf and on mine.



Brian's Final Words: in Poetry

Brian hoped to be remembered for his scientific writings **and** his poetry. It was eclectic – serious, humorous, based on myths, reality or a passing thought. The selection below is equally eclectic – if there is a theme it may be enjoyment of life and acceptance of death. Brian was perhaps, above all, a pragmatic idealist whose mantra was that It Was the Right Thing to Do.

Parallel Lines

Two lines set out together
To reach eternity;
Scribed by the finest pens, they
Were straight as straight can be;
And swore that they would never
Intersect until
The end of time: their pride would
Preserve them parallel.

Three months the lonely couple
Continued side by side,
Until the faith grew fainter
That first had been their guide.

Was still the distance constant
That kept the pair apart?
One stretched a feeling hand out
And touched the other's heart.

Perspective's jurisdiction,
It seems, they'd left behind;
Some curvature of space-time
Their paths had inter-twined.

A timeless space absorbed them
And merged them each in each:
Infinity had joined them
They'd thought beyond their reach.

Approaching death: an acrostic sonnet

At ninety-two a handful more of years
Perhaps I shall enjoy, if that's the word.
Purporting to escape this 'vale of tears'
Reluctantly appears a bit absurd.
"Or not to be?" Why not? 'Gainst Hamlet's doubt
About "perchance to dream", this counter-thought:

China... where terra cottas were dug out
Heavy with mire. Its emperor had sought
In vain to prove what mindless men desire.
Not I! 'Life after Death' misses the point.
Gratefully and in peace I shall expire
Departing times or in or out of joint.

Alarm clocks all unheeded ring. The dead
Thankfully snooze forever on in bed.

Non-Existentialism

Zero-existence I have come to terms
With: did not, do now, soon shall not again,
Exist; except as fodder for the (book-) worms.
From 'nothing' to 'no more' my path is plain.
'Birth, copulation, death: this BCD's
An alphabet most fit for mortal man.
B's bloody; D is dire; but C can please;

And boost, if there should be one, Nature's plan
It's much the same for species: dinosaurs
First were not, then evolved, are now extinct.
Maybe to sun-spots, ill-aimed meteors,
The limits of their slot of time were linked.
Considered from the stellar point of view
It's unimportant what the planets do.

The stars care not for us. No matter. We
Can take another view, if we **decide**.
Within our limits, we have liberty
Man's laughably brief life-span to deride
As nothing worth; or **not** to. That's the choice
Most make unthinkingly; and I, **with** thought,
Have chosen in existence to rejoice,
Without insisting that all others ought.
'Ought', 'should', 'good', 'better', 'best'; such words
convey
The wisdom, (so far) of the human race,
Which takes as meaningful we freely **may**;
Or else with self-devised concepts replace.
'Till Life's fount fails, my thirst for it I'll slake.
Not yet shall my bodkin quietus make.

Should this be read out at my funeral
And some feel tempted to let fall a tear,
Thank you. I say, but life's ephemeral.

Be glad: No more I'll grunting fardels bear;
Nor try to show off my Shakespearean knowledge;
Tell tales so trite table-companions groan
How William said: 'Dad works at JAM and Porridge,
And Jeremy: 'I'll do it by my own'.
To (plural) wives and families: Farewell.
To friends, acquaintances, fond lovers too;
And co-believers in my 'What-the-hell'
Philosophy; to students old and new:
A sonnet ends when the last couplet's read.
Finished with this, I'm satisfied; soon dead.

Brian's Last Poem (Found November 28, 2016)

I shall have no regrets when I am dead
Of deadlines none will matter but my own.
Unwritten papers? Hopelessly misled
Inheritors? All claimants I'll disown.
Yet hope, while still alive, there'll be but few
Who think: I was a fool to trust him.
Now that he's gone, what am I going to do?
None I would hope; but guess the chance is slim.
Yet, in that soon-to-close window of time,
There's much I want to do; and think I can.
Always too optimistic is what I'm
Dismissed as. To disprove it is my plan.
"After such labours", I would have it said,
"It must be truly blissful to be dead."