



## EDITORIAL BY THE PRESIDENT

The International Ballistics Society (IBS) is run entirely by volunteers. No one, not even me or the Board members, receives any payment from the IBS for expenses for attending meetings or anything else. The IBS has no salaried staff. I am

extremely and sincerely grateful to all the IBS members who give their time so freely and enthusiastically in supporting the IBS. There are too many people to name and thank individually but they include abstract and paper reviewers, Board members, committee members and chairs, and many more.

Much of the support takes place leading up to and during the International Symposium on Ballistics (ISB) and mainly takes the form of reviewing papers. In May 2016 the 29<sup>th</sup> ISB was held successfully in Edinburgh, Scotland. Electronic copies of many oral presentations are now available in the File Archive on the IBS website – my thanks to all the presenters who agreed to make their presentations available. Note that these presentations are for IBS members only and must not be given to anybody else. Please see elsewhere in this newsletter for further details on the 29<sup>th</sup> ISB.

At the 29<sup>th</sup> ISB Ernie Baker and James Walker were elected to the Board and I was re-elected. We will be Board members for up to 3 terms. My thanks and commiserations to the people who stood for the Board but were unsuccessful. I hope you will consider standing again next time.

In the last 6 months we have also seen some Committee Chair changes. Seokbin (Bin) Lim took over as Outreach Chair from Michael Murphy; Professor Baoming Li took over as Publications Editor from Bo Janzon; and Markus Graswald took over as Education Chair from Jack Riegel. My thanks to all of the Committee Chairs who have stepped down for all their hard work in the past. They were all responsible for setting up the IBS and have held their positions since 2010.

This term I am treating Education as the highest priority and I am delighted with the progress that Markus Graswald and his Committee members are making.

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## HELP NEEDED FROM MEMBERS!

1. **Recruit new members:** spread the word and get your colleagues to join
2. **Get involved:** see the website for a list of committees & projects with contacts
3. **Send or post cool photos:** Wanted: good photos showing ballistic events in each field
  - Interior Ballistics
  - Exterior Ballistics
  - Launch Dynamics
  - Vulnerability
  - Terminal Ballistics & Impact Physics
  - Explosion Mechanics

Upload photos at [www.ballistics.org](http://www.ballistics.org)

As always, remember to be responsible with sensitive or restricted information!

## Website developments

In my last editorial I reported that the IBS website had been modernised. Further improvements have been made including the addition of a Log Out link.

As part of the improvement process an IBS app has also been developed. This app is intended to provide better support to mobile users when on the go and away from their usual laptop or desktop computer. It gives access to membership information, the file archive and committee files. Hopefully the app will help to promote the IBS to members of the public who have an interest in ballistics. Please note that the app is not intended to provide the same functionality that is available through the website. My many thanks to the Board, Nicolas Eches and Markus Graswald who helped test the app and made comments on the design.

If you wish to install the app then please use the links below.

Android version:

<https://play.google.com/store/apps/details?id=com.viethconsulting.IBSOmainapp>

Apple version: <https://itunes.apple.com/us/app/international-ballistics-society/id1114149500?ls=1&mt=8>

Windows Phones and browser version: <http://mobile.ballistics.org>

## Downloads of individual papers from past ISB

The Board has reviewed the benefits for members and have agreed to make the following substantial improvements:

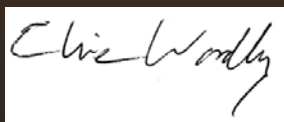
- All papers from the 1<sup>st</sup> and 2<sup>nd</sup> ISB will now be available free of charge.
- All members, individual and corporate will now have increased numbers of free downloads per term as follows:
  - Individual members increased from 5 to 10;
  - Lifetime members increased from 10 to 20;
  - Silver Corporate members increased from 5 to 10
  - Gold Corporate members increased from 10 to 20;
  - Platinum Corporate members increased from 20 to 40.

These changes have been implemented.

## Looking ahead

The next ISB, the 30<sup>th</sup>, will be held in Long Beach, USA, September 11-15 2017. Sidney Chocron and James Walker are the co-chairs for the symposium. It promises to be a tremendous symposium. Please keep your eye on the IBS website for further information and key dates. Information on the registration process will be appearing soon. I look forward to seeing you there.

If you have any views on the IBS or wish to help then please contact me. I look forward to hearing from you. My best wishes for a successful 2017.



Clive Woodley, IBS President

## LOOKING BACK TO EDINBURGH: UPDATE ON THE 29TH INTERNATIONAL SYMPOSIUM ON BALLISTICS

by Clive Woodley and Ian Cullis

The 29<sup>th</sup> ISB was held at the Edinburgh International Convention Centre, Scotland, on 9<sup>th</sup> to 13<sup>th</sup> May 2016. QinetiQ served as sponsor and host, supported by the National Defense Industrial Association, who were responsible for symposium administration. The conference co-chairs, Ian Cullis and Clive Woodley, both of QinetiQ, organised the technical aspects of the conference. The symposium was attended by 370 ballisticians from 25 countries.



Key aspects of any ISB are the intensely interactive and dynamic poster sessions, where presenters stand by their posters to discuss their research, technical approach, results, and conclusions. The poster sessions at the 29<sup>th</sup> ISB were strongly attended and provided an opportunity for scientists and engineers to network with other researchers to understand new lines of research and develop international collaborative opportunities.



The symposium opened with six keynote presentations. The first was by Paul Opie of the UK MOD Defence General Munitions Project Team. There followed three presentations by experts in their respective fields: Don Carlucci on the interior ballistics of 12-inch guns used in the Battle of Jutland in 1916, Charlie Anderson on analytical modelling of penetration mechanics, and Pierre-Yves Chanteret on shaped charges. The fifth keynote presentation was from QinetiQ on "The ballistics of the bombard Mons Meg," which is located at Edinburgh Castle. The final keynote was by Professor Baoming Li on the latest advances in railgun and electrothermal-chemical gun technology in China – the excellent quality of this work surprised many attendees and demonstrated the depth, breadth, and world-class nature of Chinese research.



The bombard Mons Meg

Awards presented at the symposium included the following:

- The Zernow Award, presented to the author of the paper reporting the most significant advancement in fundamental ballistics, was given to an internal ballistics paper, "Innovative Boron Nitride-doped Propellants," by Dr. Thelma Manning of the USA. This paper described work on the addition of nano boron-nitride to gun propellants that could result in a 2-3 fold increase in barrel life.
- The Rosalind and Pei Chi Chou Award for Young Authors was presented to Stephan Weidner, ISL, France, for "Supersonic Wake Flow Analysis of Finned Projectile Afterbodies at Various Spin Rates."
- The Neill Griffiths Award for the best paper on shaped charges was presented to Dennis Baum, G. Schebler, D. Dobie, D. Faux, and R. Kuklo, for their paper "Characterization of Shaped Charge Jet Erosion in Drilling Mud."
- The SABO Award for best poster paper was presented to E. Fousson and C. Berner for "Free Flight Tests of a Medium-Calibre Ammunition using an Impulse Thruster: Preliminary Phase."

Student awards were presented as below. Each student received a free registration for the 29<sup>th</sup> ISB and US\$1000 towards travel and hotel costs.

Explosion Mechanics	Guo Wenqi, China	Investigation on the Melting and Composition Gradient of W-Cu Shaped Charge Jet During the Jet Formation and Penetration
Exterior Ballistics	Vincent Condaminet, France	Identification of the Aerodynamic Coefficients of a Spin-Stabilized Projectile from Free Flight Data
Interior Ballistics	Na Sun, China	Enrichment of Fluorinated Nano-TiO <sub>2</sub> Composite on the Surface of Propellants
Launch Dynamics	No award	
Terminal Ballistics & Impact Physics	Matthew Hudspeth, USA	The Effect of Projectile Nose Geometry on the Critical Velocity and Failure Mode of Yarns Subjected to Transverse Impact
Vulnerability	Steffen Grobert, Germany	Experimental Investigations on Dynamic Back Face Deflection Caused by Ballistic Impact on Combat Helmets and the Effect to the Human Skull

The symposium also included important networking opportunities, including a reception at Edinburgh Castle where an excellent display of Scottish dancing was given by the Dunedin Dancers. This was extremely well appreciated by the attendees. The banquet was held in the Museum of Scotland, where the delegates were given a resounding welcome by a Scottish piper.





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## NOMINATIONS

The Edinburgh Symposium Gala Dinner was the opportunity for Clive Woodley, President of the IBS, to announce some nominations.

**Izak Snyman** became a Fellow Member of the Society.



**James Walker** became a Ballistics Science Fellow, for outstanding research in terminal ballistics. Starting from first principles, he has contributed to the understanding of the complex physics of penetration and had a leading role in the development of the world-famous Walker-Anderson penetration model. He was awarded the Holley Medal by ASME for his work on the Space Shuttle Columbia Accident Investigation. He has shared this understanding by making a significant contribution to the education and development of ballisticians around the world.



**Bo Janzon** received a special award in recognition of his outstanding meritorious service to the International Ballistics Committee and the International Ballistics Society. Bo has pioneered the organization and promotion of the publication of ballistics papers in peer-reviewed journals. He has demonstrated the highest level of professionalism at all times. His support to the Society has been singular and outstanding.



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## NEW COMMITTEE CHAIRS

Just before Edinburgh, two committee chairs became vacant, as both Bo Janzon, who was in charge of the Publication Committee, and Mike Murphy, responsible of the Outreach Committee decided to resign after many years of very efficient volunteering to the society. The board elected two new chairmen, from numerous candidates.

### **BAOMING LI, PUBLICATION COMMITTEE CHAIR**

My surname is Li and my given name is Baoming. I was born in 1966 in China and obtained my PhD degree in Ballistics from Nanjing University of Science and Technology in 1992. I am now a professor at Nanjing University of Science and Technology and director of the National Key Laboratory of Transient Physics. As a leading expert in ballistics, I have been appointed as chief scientist of China Academy of Ordnance Science since 2012. In addition, I am also a standing vice director of China Ballistics Society.



My main research interests are on hypervelocity launching, hypervelocity flight, and hypervelocity impact. More than 100 of my papers have been published in a wide variety of international and Chinese academic journals. My experiences not only offered me a deeper understanding of professional publishing, but also brought out my passion to contribute to international ballistics field at a greater level.

The Publications Committee is responsible for assisting members in publishing peer-reviewed articles. The committee works with the journal selected by the IBS to publish peer-reviewed papers that are presented at the International Symposium of Ballistics (ISB). Currently this journal is *Defence Technology*. In the future, I will focus on the following works:

1. Liaising with members of the editorial board of *Defence Technology* and China Ordnance Society to review and publish a special issue of the journal containing papers that are presented at the ISB, and I will also prepare it to be indexed by some famous databases.

Plus: If you wish to submit a paper for the special 30th ISB issue of *Defence Technology* (which is peer-reviewed and published by Elsevier), then must submit your full manuscript to the journal via Elsevier - *Defence Technology*. The submission is now opened.

2. Proposing to the IBS Board of Directors other types of publications (e.g., books and special publications) that should be considered by the IBS.
3. Assisting ISB co-chairs in the review of abstracts and manuscripts, including peer review where necessary, including:
  - (1) Recommendation of a publisher.
  - (2) Preparation of an index to the proceedings.
  - (3) Pre-publication editing of the manuscripts.
  - (4) Submission of the manuscripts to the publisher.
  - (5) Ensuring the proceedings of the ISB is published.
4. Submitting a report on the activities of the Publications Committee to the IBS every ISB.



#### **LIM SEOK BIN, OUTREACH COMMITTEE CHAIR**

My name is Seokbin (Bin) Lim and was appointed as a chair of the IBS outreach committee recently. It is my honor and great pleasure to be involved in this society as a committee chair, and I would like to thank the former outreach committee chair Dr. Mike Murphy for his dedication on this committee.

I received my degrees of M.S. and Ph.D. in explosives engineering from Missouri S&T. Right after my graduation, I became a faculty member at New Mexico Tech (NMT). Since then, my specialty has been somewhere between explosives engineering and shock physics, trying to solve various explosives related engineering issues in a shock physics point of view.

Over the ten years of my tenure as a faculty, I have learned valuable lessons about the meaning of “outreach,” as I addressed in the candidate statement. What I have learned as a academic faculty member are: 1) to cover a wide range of scientific/engineering subjects in order to produce intellectually well-equipped students and future engineers; 2) to bring in people of various levels of intellectual/social capability or interests; and 3) to connect people over distances. These may only be applicable to an academic institute, but I believe a professional society like IBS may share the same fundamentals, and this will be my direction for this committee.

It may be challenging to accomplish all those items that I addressed above. However, when we set a bit higher target and marching together as a single team, it will be easier for us to complete our given mission and tasks in a professional society.

Once again, the term of “outreach” cannot be a simple physical or electronic connection between people or groups, but this should be realized under a strong care-based interaction between members. I will do my best to make a healthy society as a committee chair, and am looking forward to your continued support in this committee.

**During the last semester, the Society faced the loss of two major members: Dennis Orphal and Ken Kuo. Here are some words to honour the memory of these great ballisticians.**

**DENNIS ORPHAL  
1942-2016**

On Thursday, September 8, 2016, Dennis Orphal, a much respected ballisticians with whom I had a long association, died. He was 74 years old.

Denny, as he liked to be called, was an outstanding ballisticians with a keen interest in terminal ballistics. He had a long and active association with the International Symposium on Ballistics (ISB). As a member of the International Ballistics Committee he worked hard to develop the ISB and was a Technical Co-chair for the first Orlando symposium.



If that wasn't enough, he was a Founding Director of the Hypervelocity Impact Society (HVIS) and served as its President (1994–1996) and Past President (1996–1998).

In December 2003, at the HVIS meeting held in Noordwijk, The Netherlands I had the honor of writing the citation and presenting Denny with the HVIS Distinguished Scientist Award. The preparation of the citation requires a degree of research into the recipient's career in ballistics. It provides an opportunity to discover unknown facts. In Denny's case I learned he had made a number of major contributions in many fields.

After graduating from Ohio Wesleyan University with a BA in physics in 1964, Denny spent three years at Los Alamos National Laboratory and then eight years at Computer Sciences Corporation, where he was able to complete his graduate studies at the University of Nevada in 1972. He worked on the design of nuclear weapons and their effects including cratering, the seismic effects of underground tests and blast loading. This research enabled him to understand earthquakes and the role of energy in defining their magnitude.

Denny spent the next 30 years of his career at Physics International and then California Research & Technology (later part of Titan Corporation), where he worked on problems in missile defense and hypervelocity impact. I can remember starting my own research work on missile defense in the UK and discovering some very clever lethality enhancement concepts had been devised by Denny. He was a major player in the US research program and was actively involved in the design and execution of many hypervelocity experiments. His very-high-obliquity experiments remain unique some 25 years later. His basic research to investigate 'direct hit' missile defense concepts, which led to his conceiving and developing the kinetic energy kill enhancement devices and used in two major Ballistic Missile Defense Office (BMDO) experimental programs, was in my opinion seminal. He was a major contributor to the lethality analysis and testing for the THAAD (Theater High Altitude Area Defense) missile defense programs.

In 1996, Denny set up his own consulting business, International Research Associates. He continued to support ballistic missile defense, as well as fundamental studies in hypervelocity impact, such as his investigations of failure waves in ceramics. He had a flair for designing 'clever' experiments to make sense of the often conflicting data. As a modeler I was always



impressed with his ability to make full use of both experiment and numerical simulations. His keen desire to understand the varied phenomena that result from impact events in terms of the governing physics and materials science was infectious. He was one of the key proponents of this integrated approach and demonstrated his abilities in both disciplines.

He had a flair for accurately applying experimental techniques, for example reverse ballistics, to obtain precise data for use in developing and validating analytic and numerical models to improve our understanding of the field. In this regard his later work with collaborators at SwRI and EMI on the penetration of gold rods remains, for me, one of the 'classic' ballistics experiments.

He used his understanding of terminal ballistics to make a significant contribution to the armor/anti-armor research effort, including advanced penetrator concepts that resulted in patents for lightweight body armor with James Walker and an innovative 'momentum trap' ballistic armor system with Charlie Anderson and Gordon Johnson.

Denny published over 140 papers in areas of cratering and ground motion, high explosive simulation of nuclear effects, dynamic structural response, and impact and penetration dynamics. A new research entrant to any of these fields seeking a sound grounding in the science would be well advised to begin with Dennis Orphal's publications.

Dennis has received many awards and honors for his research, including being a Defense Threat Reduction Agency (DTRA) 'Graybeard' for nuclear weapons effects. He took great pleasure in my calling him 'Gandalf.' It was a classic example of his wonderful personality and openness. Once a friend, you were a friend for life. He had a mischievous sense of fun, which always made a symposium with Dennis a great occasion, so much so that my wife nicknamed him 'Awful Dennis,' an accolade he readily accepted with great pleasure!

At a personal level Dennis Orphal will be greatly missed by many. The shock of his death has yet to fully sink in. As ballisticians we will also come to recognize in the years ahead what a great ballistician the community has lost.

### **KENNETH KUAN-YUN KUO 1939-2016**

Kenneth Kuan-Yun Kuo, 76, of State College, Pennsylvania, passed away on July 31, 2016, surrounded by family.

Ken was born in Kunming, China on December 17, 1939. He graduated from the National Taiwan University with a B.S. in 1961 and continued on to receive a M.S. in Mechanical Engineering from the University of California, Berkeley in 1964 and a Ph.D. in Aerospace and Mechanical Sciences in 1971 from Princeton University, where he studied under Prof. Martin Summerfield, one of our symposium's founders.



Ken retired as Distinguished Professor Emeritus after having served as Distinguished Professor of Mechanical Engineering and Director of the High Pressure Combustion Laboratory for 39 years at The Pennsylvania State University.

Ken was an internationally recognized authority on chemical propulsion and propellant combustion. He greatly impacted his field through the founding of the High Pressure Combustion Laboratory at Penn State, leadership on more than 100 scientific research projects,

and authorship of several widely used textbooks and hundreds of technical articles.

Ken received numerous awards throughout his career from various professional societies as well as from U.S. government agencies. Some of the most notable include the 2014 Ballistics Science Fellow of the International Ballistics Society, the 2011 Lifetime Achievement Award from Joint Army Navy NASA Air Force (JANNAF), and the 2011 Wyld Propulsion Award from The American Institute of Aeronautics and Astronautics (AIAA).

Ken collaborated with colleagues around the world and advised and mentored more than 140 graduate students. He considered these relationships to be the most personally fulfilling part of his work and many of these have turned into enduring friendships.

Upon retirement, Ken and his wife, Olivia, committed to continue to support advancements in the engineering program in perpetuity by endowing two Early Career Professorships in the Department of Mechanical and Nuclear Engineering at Penn State.

In his personal life, Ken loved traveling and was fortunate enough to have visited six continents in his lifetime while instilling a love of travel and exploration in his children. Ken also relished in good food, especially ice cream, both at home and wherever his travels took him. His other interests included singing, playing a friendly game of poker with friends, listening to classical music and opera, attending concerts and performances, and ballroom dancing with Olivia. Ken had an inquisitive mind and a lifelong passion for learning, which was a part of everything he did. Ken was extremely devoted to and loved by his family and friends. He maintained many close family ties and friendships spanning childhood to more recent times and from across the world to those in State College. He often treated friends like his own family. Many of us have fond memories of his smile, laughter, kindness, and thoughtfulness. Ken will always be remembered as a devoted husband, loving dad and grandfather, loyal friend, supportive mentor, and as a good man who was always there for others. He will be greatly missed by friends and family around the world. Ken is survived by his wife Olivia, two daughters, Phyllis and Angela and two grandchildren Elsa and Tate.

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## AGENDA

### 30<sup>th</sup> INTERNATIONAL SYMPOSIUM ON BALLISTICS, Long Beach, California, 11-15 Sept. 2017

- 29 Jan. 2017: Extended deadline for uploading conference abstracts to IBS website and full journal papers to Elsevier's website. See the IBS website for instructions.
- 1 March 2017: Reminder for attendees to request invitation letters for their visa applications from the symposium chairs at 30<sup>th</sup>\_ISB@ballistics.org.
- 15 March 2017: Abstract authors start being notified and invitation letters start being emailed to attendees needing visas.
- 15 June 2017: Deadline for full conference papers and extended abstracts of papers published in *Defence Technology* for inclusion in the proceedings of 30th ISB. Notification to authors of full-paper acceptance in *Defence Technology* ends.
- 30 June 2017: Online publication of *Defence Technology* papers.
- 15 August 2017: PowerPoints due. Deadline for submission of applications for the Chou Award for Young Authors.
- 19 August 2017: Last day to book hotel at special symposium rate.

See the symposium webpage for details: [http://www.ballistics.org/30th\\_isb.php](http://www.ballistics.org/30th_isb.php)

### 31<sup>st</sup> INTERNATIONAL SYMPOSIUM ON BALLISTICS, Hyderabad, India, November 2019



## LAB PRESENTATION: SOUTHWEST RESEARCH INSTITUTE

BY JAMES D. WALKER

Southwest Research Institute® (SwRI) is an independent, nonprofit, applied engineering and science R&D organization founded in 1947. SwRI's headquarters in San Antonio occupies 1,200 acres with 2600 employees.

SwRI performs experimental, computational, and analytical modeling work. Onsite ballistics ranges for small arms up to 50-mm powder guns are used for armor studies. Compressed gas guns handle bird and hail strike, turbine failure studies, and were used in the Space Shuttle *Columbia* accident investigation. Onsite and offsite explosive ranges perform experiments with small and large charges, both buried and arena style. Diagnostics include high-speed and ultra-high-speed cameras, flash X-rays, digital image correlation (DIC), accelerometers, strain gages, pressure gages, and ATDs. In 2015 a new small arms range was completed and a building to house a large two-stage light gas gun (38 mm launch tube) will be completed in early 2017. Large-scale computations include both code development and code use. The department maintains a 1000-node parallel computer. Codes in use include CTH, EPIC, and LS-DYNA, and the developers of the EPIC code, led by Dr. Gordon R. Johnson and Timothy J. Holmquist, work in SwRI's Minneapolis office.



Small arms range



Double-stage light gas gun

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International Ballistics Society

*Periodic Bulletin*

Questions, input, or feedback should be directed to [communications@ballistics.org](mailto:communications@ballistics.org)

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## LOOKING AHEAD TO LONG BEACH

The **30th International Symposium on Ballistics** will be held in Long Beach, California, 11-15 September 2017. Here is a status on the organization by James Walker.

We are progressing well towards the 30th International Symposium on Ballistics in Long Beach, California, this September. As of January 13, 165 abstracts were submitted; the abstract submission deadline was extended to January 29, 2016. We will have a full program that is in line with previous great symposia.



The venue in Long Beach, California, is part of the greater Los Angeles area. We are down near the Pacific Coast and our banquet will be at the Aquarium of the Pacific. Our hotel is adjacent to the beach and is close to the Long Beach Convention Center, where the symposium will be held. Hopefully you will recognize our symposium logo which is a play on the Hollywood sign. There are great beaches all down the coast from where we are staying: Long Beach, Seal Beach, Huntington Beach, Newport Beach, and Laguna Beach. It is possible to walk, bicycle, roller skate, play volleyball, swim, and even surf at the beaches (the water is cold). Nearest airports are Long Beach Airport (11 miles), LAX (22 miles), and John Wayne (Orange County) Airport (31 miles). Nearby attractions include Space X (19 miles), downtown Los Angeles (25 miles), Disneyland (27 miles), Hollywood (31 miles), La Brea Tar Pits (31 miles), UCLA (32 miles), the Getty Center art museum (33 miles), Universal Studios (34 miles), Cal Tech (34 miles), and NASA's Jet Propulsion Laboratory (40 miles). Of course, the distances can be a bit deceiving as traffic volume is challenging at times, which is a "feature" of Los Angeles that as visitors we should "enjoy" as "local color." The weather should be nice; in September, the daily high temperatures are typically in the low 80's (28 °C) and the night lows are typically in the mid 60's (18 °C). A heads-up for drivers: at the Hyatt Regency conference hotel, the parking fee is a little steep at \$26 per day.

We look forward to seeing you in Long Beach in September for the 30th International Ballistics Symposium. —Sidney Chocron and James Walker.



## LOOKING AHEAD TO HYDERABAD



The **31<sup>st</sup> International Symposium on Ballistics** will be held in Hyderabad, India in November 2019. Hyderabad, known as the City of Pearls, is one of India's major metropolitan cities. Founded in 1591, the city represents a confluence of the old and the new: Hyderabad is synonymous with Charminar, its 400-year-old monument, and today is known also for its pearls, bangles, silks, distinctive cuisine, and booming IT industry, which has earned it the nickname "Cyberabad." Though a modern cosmopolitan city of 6.8 million, it has retained its glorious past. Hyderabad is home to people from diverse cultures and traditions. The region is known for mines that have produced some of the world's most famous gems, including the Koh-i-Noor diamond, today among the Crown Jewels of the United Kingdom; set in the Queen Mother's crown, it is seen by millions of visitors to the Tower of London each year.



The **Charminar**, built in 1591, is a monument and mosque in Hyderabad



Venue of 31<sup>st</sup> ISB, 2019: **Hyderabad International Convention Center (HICC)**

### *Of ballistics interest ...*



**Golkonda**, literally meaning Gol konda ("round-shaped hill") or Golla konda ("shepherd's hill"), is a fort that was the capital of the Qutb Shahi dynasty (c. 1518-1687). At its entrance can be experienced an amazing acoustic effect, characteristic of its engineering marvels: a hand clap at a certain point below the dome reverberates and can be heard clearly at the "Bala Hisar" pavilion, the highest point almost a kilometer away. This served as a warning to the royals in case of attack.



The magnificent **Fateh Rahben Gun** ("guide-to-victory") in Golconda fort, c. 1888, was used by Mughal Emperor Aurangzeb's army to storm the fort and capture the last Qutb Shahi ruler, Abul Hasan Tana Shah, in 1687.



Source: <http://en.wikipedia.org/wiki/Golkonda>

## 31<sup>st</sup> International Symposium on Ballistics

## BALLISTICS HISTORY: PUNT GUNS

A **punt gun** is a very large shotgun that was formerly used for hunting large quantities of birds, mainly waterfowl. With calibers of 50 mm or even larger, punt guns could deliver almost a half kilogram of shot, which could kill as many as fifty flocking birds in a single firing.

They were called punt guns because they were typically fired from the small flat-bottomed boats, called “punts,” that were used for hunting. They were used by “market hunters,” who took game for their meat and feathers, which they sold commercially. The practice of market hunting, which is considered responsible for the extinctions of the passenger pigeon, the great auk, the Labrador duck, and the heath hen, is now illegal in many jurisdictions, including, since the Migratory Bird Treaty Act of 1918, the United States. In the United Kingdom, the practice remains legal but under heavy regulation.



(image: Library of Congress)



(image: Wikipedia, public domain)

It has been suggested that the expression “to get one’s ducks in a row” originated from the practice of market hunting and its use of the punt gun.

## DID YOU KNOW ... ?

... that **Fr. Kazimierz Żegleń**, a Polish engineer and priest, is credited with inventing the **first bulletproof vest**? After moving to Chicago, where in 1893 the mayor had been assassinated by a gunman, he began to experiment with various materials in order to develop a protective garment. On reading of a case where a man was protected from a gunshot by the silk handkerchief in his breast pocket, he focused his efforts on that fabric. He succeeded in producing a wearable vest that could stop the slow bullets from the black-powder handguns of the era.



Live-fire test of bulletproof vest made by Żegleń's collaborator, Polish inventor Jan Szczepanik (image: Wikipedia)

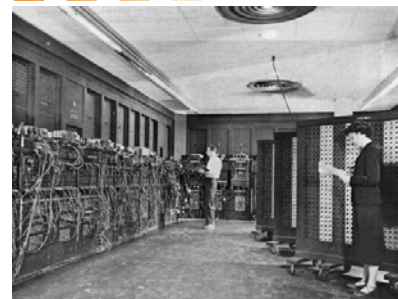
... that **Jean-Victor Poncelet** (1788-1867), French mathematician and military engineer, fought in Napoleon's invasion of Russia, where, during the 1812 Battle of Krasnoi, by some accounts he was left for dead? He was captured, interrogated, and imprisoned for two years by the Russians. On returning to France, he eventually became commandant general of the École Polytechnique, where he developed an early successful and now well-known formula for projectile penetration into various materials. A prize awarded annually in his honor for contributions to applied mathematics and mechanics was won in 1921 by **Jacques Charles Émile Jouguet** (1871-1943), a French scientist who is known for the Chapman-Jouguet condition in explosive detonation.

... that the US Army's semi-automatic **M1 Carbine**, which has been in production since 1941, was developed with technology invented by a convicted murderer? Key to its design was a patent for a short-stroke gas piston invented by **David Marshall Williams**, who had been sentenced to a 30-year prison term for killing a deputy sheriff who was a member of a party that had confiscated Williams's illegal distillery. Williams, with the help of his prison warden, the governor of the state of North Carolina, FBI Director J. Edgar Hoover, and even the slain deputy's widow, was released from prison after serving only 8 years to work for several American firearms manufacturers.

... that there is a **wiki on ballistics science** on the IBS web site? Society members are welcome to add to it, edit it, and learn from it.

---

**At a lab in Wisconsin (La Farge),  
They built a computer so large  
That it filled a great room,  
Just to get the same "boom"  
From a smaller, less sensitive charge.**



ENIAC, the world's first electronic general-purpose computer, was built to compute ballistic firing tables. (US Army photo)

### REMINDER TO YOUNG AUTHORS: THE ROSALIND & PEI CHI CHOU AWARD

The Rosalind and Pei Chi Chou Award for Young Authors is given at each International Symposium on Ballistics. Its purpose is to enrich the program of the Symposium by encouraging young authors to submit papers and attend the Symposium. To be eligible, the Young Author must be 35 years of age or younger at the time of the Symposium. The paper may have multiple authors, but the Young Author must have made a major contribution to the paper. Further, the Young Author must attend the Symposium and give the oral or poster presentation.

Young Authors are reminded that they must apply for the Award, using a special form available on the IBS website ([http://www.ballistics.org/the\\_rosalind\\_pei\\_chi\\_chou\\_aw.php](http://www.ballistics.org/the_rosalind_pei_chi_chou_aw.php)). Upload your completed application form, along with a copy of your paper, to <https://mms.ballistics.org/members/form.php?orgcode=IBSO&fid=2374025> Expect an email acknowledgment of receipt within a few days.

The Award selection is based solely on the written papers, which are judged on original contribution to the ballistic sciences. The Award consists of a plaque and a stipend, prepared by the National Defense Industrial Association (NDIA). The plaque and stipend are presented by representatives of the International Ballistics Society and the NDIA. Inquiries may be sent to [ChouAward@ballistics.org](mailto:ChouAward@ballistics.org)

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### THIS NEWSLETTER NEEDS YOU!

The newsletter is a primary means of keeping you informed about the life of the society, and about the main events it organizes. You can participate in making this bulletin more lively and closer to your fields of interest by proposing technical papers about works you have performed, or facts about ballistics you are aware of. For instance, if in browsing the web you find sites related to ballistics you think are interesting, funny, or worthy of sharing, do not hesitate to send a message to [communications@ballistics.org](mailto:communications@ballistics.org). However, be careful not to infringe any copyright or classification rules.

Also, we all belong to lots of different organizations, industries, and laboratories. It could be interesting for other members if, from time to time, one of you made a short informative presentation of its organization. This presentation should contain more information than advertising, and have the same obvious requirements about copyrights and classification.

Any other type of contribution is obviously welcomed!

Thanks in advance!



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**TDW Gesellschaft für verteidigungstechnische Wirksysteme mbH**, a wholly owned subsidiary of MBDA Germany, is experienced in the design and manufacture of warheads, and the associated fuzes and safe & arm devices. TDW designs and manufactures all kinds of warhead systems such as shaped-, blast-, blast/fragmentation-, tandem-charges and penetrators for missile system houses worldwide. Our key technologies include insensitive explosive charges with outstanding safety even under extreme mechanical and thermal threats which provide nonetheless ultimate destructive performance.



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We are in permanent contact with universities and other research organizations to include modern technologies, modern methods, and the state-of-the-art in physical and engineering research in all our products and services.

NUMERICS is proud to support the International Ballistics Society as a Corporate Member.

For further information, please visit [www.numerics-gmbh.de/en](http://www.numerics-gmbh.de/en).



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**中国兵工学会**  
China Ordnance Society

Founded in April 1964 and affiliated with the China Association for Science and Technology, the China Ordnance Society is an academic social group composed of science and technology workers for China Ordnance.

The purpose of the China Ordnance Society is to serve the defense construction and economic development by organizing science and technology workers and to promote and develop scientific ideas and disciplines. Its main task is to organize academic exchange, publish academic periodicals, promote the development of science and technology, propagate scientific information and popularize scientific knowledge.

The Society has general members, senior members and fellows and so on. It has all together 22562 members, among which more than 585 are senior members and 34 are fellows.

## R3 Technology, Inc

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R3 Technology, Inc. is proud to support the International Ballistics Society. Jack served as the founding president of the IBS and previously served as the Chairman of the 12th IBS, in addition to other positions. R3 Technology provides technical services, business development support, and short courses.

Talk to us at the 27th IBS in Freiburg.

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# Fraunhofer

## EMI

The Fraunhofer Institute for High-Speed Dynamics, known under the name Ernst-Mach-Institut (EMI) is one of the 60 institutes of the German Fraunhofer society. Fraunhofer is a non-profit organization which specialises in applied research and has close links to German government authorities. It is the biggest research organization in its field in Germany and one of the essential European research organizations.

**Southwest Research Institute (SwRI)** is a nonprofit engineering R&D center. The main facility is a 1200-acre campus in San Antonio, Texas where over 3000 employees perform contract research for both government and industry. SwRI's Engineering Dynamics Department in the Mechanical Engineering Division works on armor and impact physics.

1. SwRI maintains multiple indoor and outdoor ballistic range facilities, where small and medium arms are tested against various armor configurations.
2. At a facility further out of town large explosive tests, including land mines, IEDs, and arena tests are performed to assess the survivability of vehicles and structures.
3. Low, medium, and high-strain-rate laboratory testing facilities provide the ability to characterize materials and then develop constitutive models for use in computational tools.
4. SwRI has extensive experience with the three primary software tools used for ballistics and explosive-loading: CTH, LS-DYNA, and EPIC. SwRI has modified all three for new constitutive models and boundary conditions.

Thus, SwRI's numerical work is directly applicable and available to the armor community. The armor and shielding program at SwRI has been funded over the years by the Army, Navy, Air Force, Marines, Department of Energy, NASA, and DARPA.

Please, visit  
[www.engineeringdynamics.swri.org](http://www.engineeringdynamics.swri.org)  
for more information or  
[www.swri.org/PMSC/default.htm](http://www.swri.org/PMSC/default.htm)  
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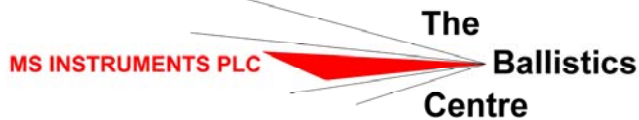
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### **ABAL : The Department of Weapon Systems & Ballistics of the Belgian Royal Military Academy**

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[www.rma.ac.be/en/rma%20-%20weapon%20systems%20and%20ballistics.html](http://www.rma.ac.be/en/rma%20-%20weapon%20systems%20and%20ballistics.html)



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