

Entangled

Graphene, Arms, Israel

and

The University of Manchester

Introduction

In the summer of 2014, Israel carried out a massive attack on Gaza for the fifth time in a decade. During “Operation Protective Edge” there were, according to UN statistics, 2220 Palestinian deaths, of whom 1492 were civilians including 551 children, while Israel suffered 71 fatalities, of whom 4 were civilians. [1]

Israel is not the only country whose military has committed such crimes. But it was founded through ethnic cleansing [2] and to this day its legal framework systematically discriminates directly or indirectly against Palestinians. [3] Israel occupies the West Bank, Gaza, and the Golan Heights in defiance of UN Security Council resolutions, maintains the Wall in violation of the 4th Geneva Convention, [4] tortures detainees including children [5 6] and makes daily life unbearable for Palestinians including students and academics. [7] This system – which is rightly called apartheid [8] – survives through financial, economic, diplomatic and military support from other governments, mainly the US but also Britain, where the story began.

Finding out how the University of Manchester (UoM) may be involved is one small response to that continuing outrage. This project started with a series of Freedom of Information requests by Huda Ammori to the UoM, where she is a student and coordinator of the Boycott Divestment and Sanctions campaign. It took 6 months and intervention by the Information Commissioner before the University answered any questions. At that stage, the aim was to identify formal relationships between the UoM and Israeli universities. The eventual answers included an unspecified research project between the Dept of Physics and Astronomy in Manchester, and the Weizmann Institute.

In October 2017, a graphene contract was signed between Versarien, an extensive commercial partner of the University of Manchester, and Israel Aerospace Industries, the State corporation deeply involved in the attacks on Gaza. In fact, there are multiple bonds between all of these elements of the story: Graphene, Arms, Israel, and the UoM. But the full saga of the University and its dance partners remains under wraps.

Perhaps none of this is news to the Vice Chancellor or the lead researchers and Heads of Department, Manchester City Council, the British or Israeli governments. But it may surprise many students, lecturers, non-academic staff and the wider public.

Graphene itself was rediscovered, isolated and characterized at the University of Manchester by Nobel-prize winning physicists Andre Geim and Konstantin Novoselov. But not all the arms and security work linking the UoM to Israel involves graphene, and versions of the rest of the story could be found at many other locations.

The booklet “Get Your Bombs Off Our Lawn” [9] looked beyond Israel to the global arms trade and the University of Liverpool. It also asked:

- Is it consistent with intellectual honesty and transparency for the University to conceal the information that, in the public interest, is required to consider these issues more fully?
- Is it in the best interests of students and staff that University research contracts are so heavily tilted towards the arms industry?
- How does the University cater for science and engineering students who do not wish to have any involvement with the military in general or with arming Israel in particular?
- Should the University be able to hide the implications of its own research or the involvement of its partners in human rights abuses and war crimes?
- Who decides which funding strands and collaborations are legitimate to pursue?

- Who benefits from those close links with the arms industry?
- What efforts have staff made to develop projects without military involvement, or to seek alternative funding using the same skills and academic and technical expertise?
- How can students influence what they are being taught if they do not know about their tutor's and department's links with the arms industry?
- Does academic freedom include the freedom to view and consider University finances?

More questions were raised in a UCU Branch resolution, which requested:

- all guidance/legal documents used in establishing the University of Liverpool's position and policy development in relation to military related/funded research.
- detail on what ethical processes currently exist in relation to military related/funded research.

In 1944, the University of Liverpool physicist Joseph Rotblat walked out of the Manhattan Project which developed the A-bombs dropped on Japan in August 1945, beginning the nuclear arms race and the Cold War. During his acceptance speech for the 1995 Nobel Peace prize, [10] he said:

I want to address the scientific community as a whole.

You are doing fundamental work, pushing forward the frontiers of knowledge, but often you do it without giving much thought to the impact of your work on society. Precepts such as 'science is neutral' or 'science has nothing to do with politics,' still prevail. They are remnants of the ivory tower mentality, although the ivory tower was finally demolished by the Hiroshima bomb.

A debate in Manchester is overdue. It is not about individual scientists. Rather, students, academic and non-academic staff, their unions and the wider public may decide that their University should have nothing more to do with arms companies or the Israeli military, and begin to untie the knots.

Huda Ammori

Greg Dropkin

Thanks to Shir Hever

1 http://reliefweb.int/sites/reliefweb.int/files/resources/annual_humanitarian_overview_2014_english_final.pdf

2 *The Ethnic Cleansing of Palestine*, Ilan Pappé. One World Oxford. 2006

3 <https://www.adalah.org/en/content/view/7771>

4 <https://news.un.org/en/story/2004/07/108912-international-court-justice-finds-israeli-barrier-palestinian-territory-illegal>

5 http://stoptorture.org.il/wp-content/uploads/2016/06/INT_CAT_NGO_ISR_23475_E-Last.pdf

6 <https://www.haaretz.com/israel-news/.premium-israel-tortures-palestinian-children-amnesty-report-says-1.5440012>

7 <https://www.theguardian.com/world/2017/jun/06/a-day-in-the-life-of-the-west-bank-occupation>

8 <http://www.independent.co.uk/voices/calling-israels-occupation-of-palestine-apartheid-isnt-lazy-or-inflammatory-its-based-on-fact-a6893706.html>

9 <http://www.labournet.net/other/1510/livarmsall.pdf>

10 https://www.nobelprize.org/nobel_prizes/peace/laureates/1995/rotblat-lecture.html

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IAI

On 22 June 2015 a UN Commission of Inquiry published its report [1] on the slaughter in Gaza which began on 6 July 2014. Khuza'a, in southern Gaza, was one of many areas to come under ferocious attack. As the UN Commission reported, Khuza'a's only clinic suffered repeated Israeli air strikes on 23 and 24 July. One of the doctors recounted:

“They targeted the clinic with three rockets from drones. There were at least 25 or 30 explosions in the neighbourhood. The attacks on the clinic continued also on the 24th. Our clinic was deprived of the most basic provisions to treat patients. [...] and in all this there was no communication or warnings. We were just attacked.”

“About thirty people in total were killed, and several more injured in these attacks. They were mostly children and women. None of them were combatants. Among them was my brother who was killed before my own eyes. He was hit during that attack and collapsed... It was the most painful experience of my life, being a doctor and not being able to save my brother's life.”

The attacks on Khuza'a had previously intensified on 22 July, “carried out for the most part from the air, by F16s and drones. Tanks in and around Khuza'a were also firing intensely. The clinic was overflowing...” Ambulances were blocked from entering Khuza'a to evacuate the wounded, or held up at checkpoints.

Such incidents were repeated during the 51 day war. But who supplied the weapons? The comprehensive report “*Sleepless in Gaza*” [2], by Dr. Atef Abu Saif, professor of political science at Al-Azhar University in Gaza, includes details of the main Israeli drone producers: Israel Aerospace Industries, Elbit Systems, EMIT Aviation Consult, and the Technion. As Saif explains:

Israel Aerospace Industries (IAI) is the leader in this regard. It produces three of Israel's main combat drones, including the Heron TP, Harop, and Harpy. Harop, which is also known as Harpy2, is 2.5 metres and carries a single high-explosive warhead of 23 kg. Upgraded versions of the Harpy are equipped with a dual sensor and datalink to allow it “to get updates on potential targets and be directed against a specific emitter.” The Heron TP (Eitan), a high-altitude, long-endurance drone weighs more than 4½ tonnes, can also carry a 1,000-kilogramme payload, is one of the leading drones used in Israel's war against the Palestinians in Gaza. It can stay aloft in the air for up to 36 hours.

IAI is Israel's prime aerospace and aviation manufacturer, wholly owned by the government, producing aerial and astronautic systems for both military and civilian usage. IAI designs and builds civil aircraft, drones, fighter aircraft, missile, avionics, space-based systems, and military systems for ground and naval forces, for domestic use and export. [3 4]. As Saif writes:

The three Israeli main military companies, Elbit, IAI, and Rafael are on the list of the world's top arms dealers. Israel is not only using its military inventions to dominate another people, it uses these people as a field test to improve the efficiency of its newly developed weapons. As Darryl Li puts it blankly, “Israel is using the Gaza Strip as a laboratory for its policies.” [5]

1 <http://www.ohchr.org/EN/HRBodies/HRC/CoIGazaConflict/Pages/CommissionOfInquiry.aspx>

2 <http://www.rosa-luxemburg.com/wp-content/uploads/2014/02/Sleepless-in-Gaza-by-Atef-Abu-Saif-RLS-Palestine.pdf>

3 https://en.wikipedia.org/wiki/Israel_Aerospace_Industries

4 <http://www.iai.co.il/2013/22031-en/homepage.aspx>

5 Li, Darryl “The Gaza Strip as Laboratory: notes in the Wake of Disengagement,” *Journal of Palestine Studies* Vol. XXXV, No. 2 (Winter 2006), pp. 38–5

EU: IAI - UoM

EU funded research projects at British universities can be identified through the CORDIS database. [1] IAI and its forerunner Israel Aircraft Industries (also known as IAI) has received EU funding via 29 projects, two of which also involved the UoM directly, and another indirectly.

AFLONEXT [2] is a 5 year current project due to end on 31 May 2018, concerning “flow control technologies for novel aircraft configurations to achieve a quantum leap in improving aircraft’s performance and thus reducing the environmental footprint.” UoM’s School of Mechanical, Aerospace and Civil Engineering (MACE) participates with wind tunnel studies of “fluidic trailing edge controls for civil transport aircraft”. [3]

The total budget exceeds €37m with EU funding of €23.6m, whose recipients include UoM (€129,078), Tel Aviv University (€248,838), IAI (€85,391), and a number of European aerospace firms involved in civil and military production. The project coordinator Airbus Operations (Germany) is joined by five other Airbus companies, receiving over €6m in all. The Aircraft Research Association, with representation from Airbus, BAE Systems, and Dowty Propellers (part of GE Aviation [4]), received €351,780. Other EU recipients included BAE Systems (€378,158), Dassault Aviation (€324,180), GKN Aerospace (€50,000), Safran (€289,000), and the Deutsche Zentrum fuer Luft und Raumfahrt (German Aerospace Center, €4,256,353). All of these firms engage in military aerospace, and many have direct connections to Israel. For example:

Airbus, previously EADS, is the second largest arms producer in Europe and the seventh largest in the world. [5] Airbus incorporate Spike missiles supplied by the Israeli arms firm Rafael, in helicopters for sale worldwide. The Airbus Eurocopter Panther is in service with the Israeli Air Force on maritime patrol. [6 7]

BAE Systems is the world's third largest arms producer, making fighter aircraft, warships, tanks, armoured vehicles, artillery, missiles and small arms ammunition. It has military customers in over 100 countries and around 93% of its sales are military. [8] BAE applied for 1,593 UK military export licences during 2008 – 2015. [9] In 2006, the Serious Fraud Office dropped an investigation into corruption in sales to Saudi Arabia when Prime Minister Tony Blair intervened on national security grounds. The case continued in the US, ending in a plea bargain with the US Dept of Justice which was settled with a \$400m criminal fine.

Selected combat aircraft in the F-16I fleet (delivered to the Israel Defense Forces) were equipped with BAE Systems Head-Up Display units, an arrangement defended in 2002 by the then Foreign Secretary Jack Straw after fifteen people including nine children were killed during a “targetted attack” on Gaza. [10] BAE's wholly-owned Jerusalem subsidiary Rokar helped upgrade F-16s with “close collaboration between Israeli defense industries, the cooperation of Lockheed Martin the F-16 original manufacturer and the assistance of the Israeli Ministries of Defense and Finance”. [11] Rokar supplies Electronic Countermeasures including chaff and flares for use on F-16s and other military aircraft. [12] In close collaboration with the Israel Defense Forces, Rokar also produces a guidance system for artillery shells “to hit designated targets in urban environments with friendly forces nearby”. [13]

GE Aviation supplies engines for 126 F-16s in the Israeli fleet. [14] When GE signed an agreement with a subsidiary of Israel Aircraft Industries in 1999, the company proclaimed “GEAE engines power most of the front-line fighter aircraft and helicopters of the IAF, and are competing for the engines for new IAF fighter aircraft now under consideration.” [15]

MULTIPROTECT [16] was an earlier EU funded project involving the UoM and IAI, seeking to develop protection against corrosion using “smart nanocomposite materials with new nanoparticles” in place of heavy metals like chromium, a carcinogen. The Executive Summary mentions tests on an Israeli aerospace piston rod. [17] EU funding totalled €8,789,000 but individual allocations are not shown. Other recipients included the Israeli firm SHL-Alubin Ltd., the Technion (Israel Institute of Technology), and EADS (now Airbus). Alubin supplies Israeli military industries including RAFAEL, El-OP, and Elbit. [18] Technion is the foremost Israeli university doing military research, as discussed later. UoM involvement included a School of Materials PhD thesis using samples from EADS. [19]

IAI also participated in MAGFORMING [20], concerning “plastic processing of wrought magnesium alloys for aeronautical applications”. The project was coordinated in Israel by PALBAM Metal Works. PALBAM designs, manufactures and supplies a wide range of metal projects and components for the aerospace and defence industries, high pressure units for missiles and rockets, missile tubes and launchers, and custom components. PALBAM is a certified supplier of the IDF and Rafael. [21] Alubin and Airbus also participated in MAGFORMING. The Manchester partner was Magnesium Elektron, which in turn has a long history of research collaboration with and recruitment from the UoM School of Materials. [22 23]

Through these three EU funded projects, UoM contributes to IAI and to other aerospace firms which in turn are part of the international arms trade, including military trade with Israel.

- 1 https://cordis.europa.eu/home_en.html
- 2 https://cordis.europa.eu/project/rcn/109010_en.html
- 3 <http://www.mace.manchester.ac.uk/our-research/facilities/wind-tunnels/>
- 4 <http://dowty.com/about-us/milestones/>
- 5 <https://www.caat.org.uk/resources/mapping/organisation/3815>
- 6 <http://i-hls.com/2014/12/israeli-missile-european-helicopters/>
- 7 https://en.wikipedia.org/wiki/Eurocopter_AS565_Panther
- 8 <https://www.caat.org.uk/resources/companies/bae-systems>
- 9 <https://www.caat.org.uk/resources/company-licence-appls-2008-2015.xlsx>
- 10 http://www.publications.parliament.uk/pa/cm200102/cmhansrd/vo020723/debtext/20723-03.htm#20723-03_spnew19
- 11 <http://www.iai.co.il/Shared/UserControls/Print/PopUp.aspx?lang=en&docid=22435>
- 12 <http://www.baesystems.com/en/product/countermeasures-dispensing-systems>
- 13 <https://www.baesystems.com/en/product/silver-bullet--precision-guidance-kit>
- 14 <http://www.flightglobal.com/news/articles/paint-flakes-ground-israeli-f-16-fighters-374828/>
- 15 https://web.archive.org/web/20150906233909/http://www.geaviation.com/press/services/services_19990217.html
- 16 https://cordis.europa.eu/project/rcn/74839_en.html
- 17 https://cordis.europa.eu/docs/publications/1201/120142281-6_en.pdf
- 18 http://www.israel-export.co.il/Industrial_Cooperation_in_Israel/pdf/Rashpat_297.pdf
- 19 <https://www.escholar.manchester.ac.uk/uk-ac-man-scw:124590>
- 20 https://cordis.europa.eu/project/rcn/79959_en.html
- 21 <http://www.army-technology.com/contractors/missiles/palbam/>
- 22 <http://www.materials.manchester.ac.uk/our-research/research-impact/magnesium-alloys/>
- 23 <http://www.materials.manchester.ac.uk/study/careers-and-employability/employers/magnesium-elektron-uk/>

EU: Israeli military / security - UoM

The Israeli military and security sectors enjoy many other EU funded collaborations with UoM, apart from those which involve IAI as a direct recipient. For example:

3AS [1] – Active aeroelastic aircraft structure – ran from 2002 to 2005 and involved the UoM with Technion and European arms firms EADS, Airbus España, Alenia Aeronautica, the German Aerospace Center, and Saab. It aimed to “ensure optimum efficiency at all flight and payload conditions through continual adjustment of the aircraft shape”. The book Adaptive Structures: Engineering Applications [2] includes a chapter entitled Adaptive aeroelastic structures, written by Prof Jonathan E Cooper, at UoM from 1989 – 2007, in the School of Mechanical, Aerospace and Civil Engineering (MACE). Acknowledging the support of 3AS and mentioning UoM colleagues Mike Amprikidis and Otto Sensburg, Cooper writes:

It is likely that the first implementations of adaptive aeroelastic structures will be in UAVs [drones]. This is due to the economies of scale and in particular the reduced forces that are required. There is a current research interest, driven by stealth requirements, in developing flapless UAVs where adaptive aeroelastic structures could make a big contribution, possibly in combination with flow control technologies. There is also much interest in HALE (High-Altitude Long-Endurance) or Sensorcraft UAVs where the extreme flexibility of very high-aspect-ratio structures could benefit from the use of adaptive stiffness technologies.

A paper by Cooper “Adaptive Stiffness Structures for Air Vehicle Drag Reduction” [3] funded through 3AS was published by NATO as part of the AVT-141 programme (Multifunctional Structures/Integration of Sensors and Antennas) [4]

Flapless UAVs were the subject of a 5 year collaboration FLAVIIR funded by BAE and the EPSRC (Engineering and Physical Sciences Research Council) involving UoM (MACE) and 9 other British universities. [5]

A paper by TECHNION research staff B. Moulin and Prof. M. Karpel “Gust Loads Alleviation Using Special Control Surfaces” [6] concerns wind tunnel tests as part of 3AS. Aeroelasticity is a main research theme for Prof. Karpel, formerly at IAI. [7]

In a similar vein, the UoM hosted a talk on Optimisation of Aerodynamic Shapes in Engineering Environment, presented by Prof S Pegin, Israeli Aerospace Industries, 12 November 2008. [8]

SNIFFER [9] – A bio-mimicry enabled artificial sniffer – ran from 2012 to 2015 and recipients included UoM (€493,552), the Israeli firm Tracotech Security (€168,000) and the Ministry of Public Security (€67,320). The Ministry is the Israeli government agency which oversees the Police, Prison Service, Fire and Rescue Authority, Anti-Drug and Alcohol Authority and the Witness Protection Authority. [10] The Ministry also covers the Border Police, who operate at the Apartheid Wall, oversee house demolitions, repress nonviolent Palestinian demonstrators, arrest and abuse children. [11 – 15] Tracotech list both the UoM and the Israeli Police among their partners. [16]

The SNIFFER project description begins:

The capture and analysis of odours offers significant potential for border security applications related to the detection and analysis of persons, illegal substances and in particular explosives. Dogs - the most effective “tool” for detecting and analysing odours - can only be trained for a small sample of odours, get easily tired and are often perceived as intrusive by the public.

The SNIFFER project proposes a highly innovative one-stop shop approach to complement dogs and leverage their capabilities... The SNIFFER devices to be developed combine in a one-stop shop sampling, pre-concentration and pre-treatment with bio-mimicry, synthetic diamond sensor technology and multi-parametric training software. This will enable the detection of odours arising out of security threats which may occur in a panel of border security applications...

SNIFFER is a major project in the UoM School of Chemical Engineering and Analytical Science [17] and a report “Grafting odorant binding proteins on diamond bio-MEMS” [18] funded via SNIFFER was co-authored by Prof K. Persaud [19] at the School.

- 1 https://cordis.europa.eu/project/rcn/63059_en.html
- 2 Adaptive Structures: Engineering Applications. David Wagg, Ian Bond, Paul Weaver, Michael Friswell. John Wiley & Sons, 9 Apr 2008
- 3 <https://www.sto.nato.int/publications/STO%20Meeting%20Proceedings/RTO-MP-AVT-141/MP-AVT-141-15.pdf>
- 4 <https://www.sto.nato.int/publications/STO%20Meeting%20Proceedings/Forms/Meeting%20Proceedings%20Document%20Set/docsethomepage.aspx?ID=33665>
- 5 <https://web.archive.org/web/20110711005454/http://www.flaviir.com/home.htm>
- 6 <https://arc.aiaa.org/doi/abs/10.2514/1.19876>
- 7 <http://aerospace.technion.ac.il/person/karpel-moti/>
- 8 www.mace.manchester.ac.uk/our-research/seminars/archive/index.htm?year_select=2008
- 9 https://www.cordis.europa.eu/project/rcn/102348_en.html
- 10 https://www.gov.il/en/Departments/ministry_of_public_security
- 12 https://www.gov.il/en/Departments/publications/reports/ie_17_border_police
- 12 <http://imemc.org/article/72719/>
- 13 <https://www.stopthewall.org/2016/06/20/new-violent-demolition-south-hebron-hills>
- 14 <http://mondoweiss.net/2018/03/anniversary-nonviolent-resistance/>
- 15 <https://www.hrw.org/news/2016/04/11/palestine-israeli-police-abusing-detained-children>
- 16 <https://www.tracetechsecurity.com/our-partners>
- 17 <http://www.ceas.manchester.ac.uk/our-research/themes-challenges/themes/ias/>
- 18 <https://hal.archives-ouvertes.fr/hal-01005176v2/document>
- 19 [https://www.research.manchester.ac.uk/portal/en/researchers/krishna-persaud\(e1566e46-12eb-41ed-af14-937f42255f4e\).html](https://www.research.manchester.ac.uk/portal/en/researchers/krishna-persaud(e1566e46-12eb-41ed-af14-937f42255f4e).html)

Graphene - arms firms - Israel

Even before graphene was isolated at the UoM in 2004 by Nobel Prize winning physicists Prof. Andre Geim and Prof. Kostya Novoselov, arms companies, the US military, and Israel were looking at the defence potential of the new nanotechnologies.

A few months after the invasion of Iraq, the 2nd 'Defence Nanotechnology' Conference was held in London in November 2003, organised by Defence Event Management in association with the Institute of Nanotechnology. [1] Entitled “Bridging the Gap between Technology and Applications”, it covered

- multifunction adaptive (smart) materials
- nanoengineered functional materials
- chemical/biological agent detection/destruction
- active chameleon style camouflage systems for wide ballistic protection
- interactive textiles/clothing that provide passive insulation, electromagnetic and radio frequency shielding
- energy harvesting, waste disposal, water recovery and recycling

Speakers were confirmed from the University of Manchester, US Army, US Navy Research Laboratory, QinetiQ Nanomaterials, Lockheed Martin, Tel-Aviv University, and the Israel Research Center Polymate.

After the physics discoveries at UoM, relationships with the defence industry and Israel developed along several tracks, including the National Graphene Institute (NGI, at UoM), the Graphene Engineering and Innovation Centre (GEIC, at UoM), and the Graphene Flagship (EU funded research projects with a total budget of €1bn).

NGI

The NGI opened in 2015, funded with £38m from the government but otherwise dependent on the UoM. [2] It was intended to develop “graphene technology to a proof-of-concept stage”, to enable commercial products. To bolster funding, the NGI turned to industry, and arms firms stepped in. During a 2016 Parliamentary Inquiry, the UoM mentioned partners including BAE. [3] Other military and civil-military companies now appear on the NGI partnership page: Airbus, DSTL, QinetiQ, Lockheed Martin, Morgan Advanced Materials, the Office of Naval Research, Rolls-Royce, Samsung, Siemens, and Thales. [4]

The newly appointed CEO for Graphene@Manchester which includes the NGI and GEIC is James Baker, who became NGI Business Director in 2014. He had worked at BAE Systems for 16 years, including director posts in the BAE Systems Avionics Group, BAE Systems PlatformSolutions, Managing Director for BAE Systems Advanced Technology Centre, and as Vice President - Technology Collaboration Programmes. [5 6 7]

BAE and **Airbus** were profiled above (see p 5).

Thales is the world's 11th biggest arms company, with military equipment comprising 52% of its sales. [8] Thales applied for 1,158 UK military export licences during 2008 – 2015. [9] The Watchkeeper WK450 [10] is a drone provided to the British Army under an £800 million contract from Thales UK [11] and Israeli firm Elbit Systems [12] and is based on Elbit's Hermes 450, widely deployed over Gaza. In 2011, Amnesty International said British soldiers were being trained in Israel in the use of unmanned aerial vehicles (UAVs), “field-tested on Palestinians” during IDF

operation Cast Lead in the Gaza Strip in 2009. [13] Thales research includes “Graphene based electrodes for high performance supercapacitors”. [14]

Lockheed Martin, headquartered in the US, is the world's biggest arms firm. [15] Aircraft include the widely-sold F-16 and the massive F-35 stealth combat aircraft programme. Missile systems include the submarine-launched Trident missile, the main element in the strategic nuclear force of the US and UK. Lockheed's UK arm applied for 105 military export licences during 2008 - 2015, including 2 to Israel. Other sales are direct from the US, including the current F-35 supplies to Israel and the previous F-16 exports. [16] Lockheed's military interest in graphene includes its use in Lithium-Ion batteries, used to power drones. [17 18]

The UK government Defence Science and Technology Laboratory (**DSTL**) is an agency of the Ministry of Defence, covering all military research apart from nuclear weapons. [19] Priority areas include Command, Control, Communication, Computers, Intelligence, Surveillance and Reconnaissance, Weapons, and Platform Systems. Its Materials for Strategic Advantage programme mentions graphene. [20] DSTL, Airbus and Morgan Advanced Materials were end-user partners in an EPSRC-funded research project “Delivering Graphene as an Engineering Material” led by Prof IA Kinloch at UoM School of Materials. [21] Project applications included development of polymer composites for aerospace and electrodes for energy storage (rechargeable batteries and fuel cells).

In 2016, the Accelerating Graphene Exploitation in Aerospace (AGEA) consortium (including the University of Central Lancashire, the National Graphene Institute, Haydale and Qinetiq), demonstrated and flew a drone with a wing skin made from graphene enhanced polymer composites. [22 23]

QinetiQ is the 6th largest UK arms company having been privatised from the MoD in 2001. [24] The company are "experts in defence, aerospace and security" and a "world leading" supplier of military robotics. Its 2017 Annual Report refers to unmanned autonomous combat systems for air, ground and sea. [25] Its interest in nanotechnology includes batteries, supercapacitors, and graphene for nanoelectronics. [26] QinetiQ applied for 147 UK military export licences during 2008 - 2015, including 5 to Israel.

Rolls-Royce is the world's 17th largest arms company [27] producing military aircraft engines, naval engines and cores for nuclear submarines. It applied for 393 UK military export licences during 2008 – 2015. Rolls-Royce and QinetiQ are amongst the partners in ongoing EPSRC-funded research at UoM (“Electrochemical Energy Storage with Graphene-Enabled Materials”, led by Prof. RAW Dryfe in the School of Chemistry) to develop Lithium batteries and supercapacitors incorporating graphene. [28 29].

Morgan Advanced Materials, incorporating NP Aerospace, supplies Security and Defence markets. [30 31] As well as the EPSRC project mentioned above, it collaborates with UoM in research on graphene production. [32]

The **Office of Naval Research** (ONR) coordinates, executes, and promotes the science and technology programs of the United States Navy and Marine Corps. [33] The Electronics Science and Technology Division of ONR's Naval Research Laboratory is interested in graphene. [34 35]

Samsung has incorporated graphene in lithium-rechargeable batteries.[36] It has a drone, robotics and virtual reality lab. [37] It has signalled its intention to increase investment in Israel. [38]

Siemens produces naval technology, [39 40] and has a contract with BAE for software used in Trident submarine development. [41]

GEIC

The Graphene Engineering Innovation Centre (GEIC), due to open in 2018, will “see industry-led development in applications through partnership with academics”. [42] The initiative was backed by former Chancellor George Osborne as part of the Northern Powerhouse, and is funded through:

- £15m - Higher Education Funding Council for England's UK Research Partnership Investment Fund.
- £30m - Masdar, the Abu Dhabi-based renewable energy company owned by Mubadala.
- £5m - Innovate UK.
- £5m - European Regional Development Fund.
- £5m- Local Growth Fund

The GEIC Advisory Council [43] includes many of the firms profiled above: **Airbus**, **BAE Systems**, **DSTL**, **Morgan Advanced Materials**, **Siemens**, **Thales**. It also includes **Versarien**, whose relations with UoM and Israel Aerospace Industries are discussed later.

Speaking at the “topping out” ceremony for the GEIC construction site last October, [44] Professor Dame Nancy Rothwell, President and Vice-Chancellor of The University of Manchester said :

“We are grateful to all of the funders for their investment into what promises to be an incredible asset. This building, and the work which will take place within it, will give us a huge number and range of opportunities.”

Graphene Flagship

The Graphene Flagship represents a new form of joint, coordinated research on an unprecedented scale, forming Europe's biggest ever research initiative with a budget of €1 billion. [45] The core consortium consists of over 150 academic and industrial research groups in 23 countries. The project has associated members incorporated in the scientific and technological work packages from the Horizon 2020 phase (1 April 2016 – 31 March 2018), during which partnership projects are expected to finance 50% of the budget. [46]

Core partners include **Thales** and **Airbus**, while **BAE** and **Versarien** are associated members. [47] The UoM is a key academic member of the core consortium, playing lead roles in the Work Packages on “Enabling Research”, “Biomedical Technologies”, and “Polymer Composites”. [48]

The **Technion** (Israel Institute of Technology) is the only Israeli core member. As earlier, Technion is one of the four main Israeli drone producers mentioned in “Sleepless in Gaza”, and a collaborator with UoM in the MULTIPROTECT and 3AS projects. It developed an unmanned version of the militarised Caterpillar D9 bulldozers which destroy Palestinian homes and clear the path for tanks during ground invasions. [49] Technion's extensive military roles were detailed in a research report for campaigners at McGill and Concordia Universities. [50]

As part of the Graphene Flagship Consortium Agreement, Technion is entitled to transfer any results without prior notice, to its commercial arm Technion Research & Development Foundation Ltd. [51] In turn, the TRDF includes a clearing house of current calls for proposals, such as this one from the US Dept of Defense / Defense Advanced Research Projects Agency (DARPA): *Innovative Systems for Military Missions* [52] whose webpage [53] shows the attached call [54]. DARPA explains “Innovative systems are platforms, weapons, integrated systems or critical systems components that often incorporate emerging advanced technologies and enable revolutionary improvements to the capability, efficiency and effectiveness of the military.”

We don't know whether research as part of the Graphene Flagship will end out with DARPA, but there appears no barrier to it doing so.

The Technion member of the Graphene Flagship General Assembly is Prof. Boaz Pokroy, [55], who leads the Bio-Inspired Surface Engineering and Biomineralization Lab [56] in the Dept of Materials Science and Engineering. As part of the Flagship, Prof. Pokroy contributed to research to enable production processes for Graphene-Related Materials. [57] The paper refers to its potential application to polymer composites, one of the Work Packages led at UoM and relevant to aerospace. Prof. Pokroy is also part of the Russell Berrie Nanotechnology Institute. [58] The RBNI itself waxes lyrical over industrial cooperation: [59]

Strengthening the contacts with industry is one of RBNI's highest priorities. As it is generic and multidisciplinary, Nanotechnology and science poses unique challenges in commercialization. To address this need, RBNI initiated dozens of meetings with industry, including open days with companies such as Intel, IBM, Elbit, Rafael, Israel Aircraft Industry (IAI), and Applied Materials. In 2010, RBNI initiated a series of short workshops to inform people from industry on the wide spectrum of infrastructure capabilities on campus, under the auspices of the RBNI.

Another strand of Technion Graphene Flagship research is entitled "Smart Thermal conductive Al MMCs by casting". [60] The project, with applications in aerospace, aims to integrate graphene materials into Aluminium cast parts to increase their ability to dissipate heat [61] [62]. The Technion researcher is Shai Essel in the Israel Institute of Metals.

Another Technion strand is "Battery and superCapacitor ChARAcTErization and testing". [63] The Technion researchers are Prof Yair Ein-Eli and Dr. Alexander Kraysberg in the Dept of Materials Science and Engineering. The project aimed to improve the performance of lithium-ion batteries and graphene supercapacitors. As above, lithium-ion batteries are used in powering drones.

Yet another strand is "BSICS – Beam Shaping in Complex Systems", [64] an EU project assigned only to the Technion. The project report links to three highly technical papers on nano-photonics, variously co-authored at Technion by Hanan Herzig Sheinfux, Ido Kaminer, Mordechai Segev, and Bo Zhen, and the project also mentions Prof Gadi Eisenstein. Two of the papers were partially supported by the US Air Force Office of Scientific Research, [65] and two partially supported by the Army Research Office through the Institute for Soldier Nanotechnologies. [66]

In sum, the UoM is directly involved with the arms industry at the NGI and GEIC, while the Technion is directly involved with the arms industry in Israel and the US, and both are part of the Graphene Flagship. But that's not where it ends.

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UoM - Versarien - IAI

Two weeks after the “topping out” ceremony at the Graphene Engineering Innovation Centre, the GEIC Advisory Panel partner Versarien entered a collaboration agreement with Israel Aerospace Industries to develop graphene-enhanced aerospace composites. [1] Versarien said that IAI had agreed to buy its Nanene technology, to incorporate it into composite panels for testing and evaluation with the potential to develop it commercially. [2]

Versarien CEO Neill Ricketts spoke to DirectorsTalk on 1st November: [3]

So, dealing with any Israeli company is challenging and this is a defence company so there's a huge amount of confidentiality and even to get a quote is a real achievement. What we have here is the ability to be able to take our materials and work closely with the guys in not only in aircraft but in defence projects and space projects and so on. They're extremely enthusiastic, they want to get going straight away...

On the Vox Markets Podcast, [4] Ricketts exuded:

This is massive news for us as a company and for the industry in general. The Israeli Aerospace Industry do not put press releases out as a rule, and they've been very kind to us in allowing us to name them. They're extremely enthusiastic to use these next generation materials in their products. They've got 16,000 employees and they turnover 4 billion dollars. This is not a small company and to have them on board as a partner is phenomenal news for us. It's obviously the first aerospace application for us as well... They're a very interesting company. They're involved in everything from space vehicles to passenger jets. They have a huge defence sector to their business as well. 77% of their business is actually export, so although they're based in Israel, these products end up all over the world.

Previously, Ricketts told DirectorsTalk that Nanene is “our baby product, coming out of the University of Manchester campus”. [5] As the Nanene website explains, the patented process builds on “techniques originating from University of Manchester, refined by University of Ulster and 2-DTech.” [6] The latter received a £240,000 University of Manchester proof of concept grant for the commercialisation of the process. [7]

2-D Tech

In 2012, the Manchester Graphene Supply Company was renamed 2-DTech. It was wholly owned by UoM, whose researcher Dr Branson Belle was a director, joined in Feb 2014 by Prof Colin Bailey, Vice President and Dean of the Faculty of Engineering. [8] Two months later, Versarien acquired 85% of the share capital for £440,000 to be settled by a mix of cash and new ordinary shares. [9] The University welcomed the deal. [10]

In a letter to Shareholders, Versarien explained the background:

Following completion of the Acquisition, the Enlarged Group aims to establish the largest production facility in the UK for the manufacture of graphene. The Enlarged Group will seek to harness the Versarien team's skill set to commercialise and scale up graphene technology in collaboration with The University of Manchester. Versarien initially intends to select two 12 month rapid commercialisation projects to advance with The University of Manchester and discuss further collaborative projects. [11]

Versarien also agreed to share in the intellectual property rights, and to pay the University and Dr Belle total royalty payments of up to £300,000, with the University receiving 94.8% and Dr Belle 5.2%.

In November 2014, Versarien's Update on 2-DTech added:

Dr. Aravind Vijayaraghaven, who is a lecturer in Nanomaterials at the University of Manchester, and is the public engagement coordinator for the National Graphene Institute, has joined 2-DTech as a Senior Consultant. The Board believes that Dr. Vijayaraghaven's reputation in the industry of nanomaterials and in the field of graphene will be of significant benefit to 2-DTech as it embarks on a number of planned collaboration projects. [12]

Later that month, 2-DTech signed a Memorandum of Understanding with The National Graphene Institute to become a project partner of the NGI. [13 14]

Directors

Versarien PLC has 3 Board members:

Neill Gareth Ricketts - CEO of Versarien since 25th February 2013 (Date of incorporation)

Christopher Michael Leigh - CFO of Versarien since 3rd July 2013

Prof. Iain Gilmour Gray - appointed February 2016 (Non-executive Director)

Ricketts and Leigh are both former directors of Elektron PLC, the Cambridge firm now called Elektron Technology PLC.

Prof. Gray, now at Cranfield University, has 27 years industrial experience including roles at British Aerospace, BAE Systems, and then Managing Director at Airbus UK. In 2007 he became the first Chief Executive of the Technology Strategy Board, later renamed Innovate UK, and remained in post until 2015. [15 16]

In April 2012, Iain Gray met with Nancy Rothwell to discuss graphene:

“During the month I met with Dame Nancy Rothwell, president and vice-chancellor of Manchester University, and we discussed the three main issues surrounding graphene — the science; the identification and development of applications; and the manufacture of it in industrial quantities.” [17]

Gray was in post at Innovate UK when it awarded grants of £80k and £98k to 2-DTech [18] and £5m towards the GEIC in 2014. [19]

UoM Shares

On 31st October 2016, UoM took shares in Versarien PLC at a massive premium to the market price. [20] The agreement had £191,500 of loans and collaboration fees converted into Versarien shares at a price of 19.14p, compared with the then market price of 11.65p. The new shares amounted to 0.83% of Versarien's shares in issue. UoM retained the remaining 15% of 2-DTech. Clive Rowland, chief executive of UMI3, UoM's innovation company, said “the involvement with 2-DTech was an important bridge between the work taking place on campus and potential customers for graphene in a range of industry sectors.”

Rowland did not mention potential customers in the arms industry. But Versarien was already looking to Israel Aerospace Industries.

UKTI

Speaking about the origins of the IAI deal, Neill Ricketts told DirectorsTalk on 1st November 2017 “So, this came as a result of a Department of International Trade trade mission to Israel about 18 months ago and we’ve been working hard on this.” [21] In the audio version, recorded on 31st October and published on Vimeo, [22] Ricketts said “this came as a result of a UKTI, it's now the Department of International Trade, trade mission to Israel about 18 months ago...”

The chronology puts the mission around April / May 2016, well before the UoM took premium shares in Versarien. The UKTI was abolished after the Brexit referendum in June and replaced by the DIT in July 2016.

The mission could have been earlier, as Ricketts told the Vox Market Podcast: [23]

It's interesting, this came out of a UK government trade mission to Israel a couple of years ago and you know, these things do take time.

The UKTI held a high profile trade mission to Israel in February 2016. [24] It concerned Cyber Security and was led by the Cabinet Office Minister Matthew Hancock MP [25 26]. The UK government report of the mission concluded:

In a sign of increased British interest in innovation coming from Israel, the Minister was accompanied by executives from major British companies, as well as cyber security professionals from government and academia. The delegation, led by the British Embassy’s UK Israel Tech Hub, [27] focused on sharing expertise in cyber security, good practice, identifying areas of mutual interest. It also explored forging collaborations with leaders of Israel’s cyber security ecosystem, such as Ben Gurion’s University CyberSpark, Israel Electric’s CyberGym, and numerous private sector companies.

Whether or not Neill Ricketts was on this delegation, Matthew Hancock may have mentioned him or his company. They had both attended the Startup Europe Comes to Silicon Valley (SEC2SV) conference in San Francisco on 22 September 2015, as mentioned in a Versarien press release and shown on the conference website. [28 29]

Hancock also knew the UoM. As Skills Minister he had shared a platform with Nancy Rothwell to announce an Apprenticeship programme in 2013. [30]

For good measure, Hancock was also a high profile opponent of Boycott Divestment and Sanctions, with a policy announcement timed for his meeting with Israeli President Netanyahu during the Feb 2016 Trade Mission. [31 32] The High Court later ruled against the government's attempt to prevent local authorities from choosing not to buy goods from Israeli settlements. [33]

It's easy to imagine Matthew Hancock encouraging a deal between Versarien and IAI.

Israeli Partner

The graphene composites which interest IAI need to be shaped. In November 2014, Versarien formed “a 50:50 joint venture with Dimar Limited, a leading manufacturer of cutting tools based in Israel, to distribute a new range of tooling for the composites industry. The new venture, DV Composites Limited, will leverage Versarien’s existing sales channels into the automotive, aerospace and marine sectors.” [34]

In 2014 the Fimi Group bought 70% of Dimar, becoming the majority owner. [35] Fimi is an Israeli holding group specializing in security. It bought all of the remaining G4S assets when G4S left Israel. [36] Fimi invests in Tadiran Communications, which supplies the Israel Defense Forces and

military organizations in over 40 nations. [37] Fimi also invest in IAI's ImageSat International, which provides space intelligence to armies, governments and commercial customers to obtain visual intelligence and up-to-date snapshots of the target area. [38] As Israel's largest investment fund, it is easy for Fimi to control the military applications of DV Composites products and to have first pick in integrating them into their security and military lines.

Batteries and Heat Sinks

There are other reasons why Versarien may have interested IAI. As mentioned earlier, graphene batteries and supercapacitors can be used in drone propulsion. In 2016, Versarien signed a memorandum of understanding with Warwick Manufacturing Group to collaborate on the production of power storage devices, using graphene nano platelets. [39]

Heat sinks are a key component in military aerospace design. [40 41] As Versarien Technologies Defence & Aerospace page explains, [42] "Thermal management is becoming an increasingly important and challenging aspect for today's designers of defence and aerospace equipment."

In 2015, Versarien Technologies appointed Mouser as a global distributor for its heat sink products, currently on sale in Mouser's Israeli outlet. [43 44]

Versarien at Technion

Innovate UK and the UK Israel Tech Hub organised a technology visit to Israel for commercializing advanced materials, in late February 2018. A twitter screenshot shows Neill Ricketts at the Technion during this trip, [45] just to the left of the window. A close-up can be compared to his selfie with the UK ambassador David Quarry, captioned "another day, another ambassador and embassy".





Neill Ricketts @neillricketts · Mar 1
 Another day another ambassador and embassy @ukinisrael talking advanced materials @KTNUK_Materials @KTNUK



The mutual attraction of Versarien, Israel Aerospace Industries and Technion is no mystery. The question is whether UoM students and staff want anything to do with it.

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UoM - Israeli Universities

This project began with a wide ranging Freedom of Information request in March 2017 for the UoM to provide, amongst other things:

The partnership between the University of Manchester and Technion - Israeli Institute of Technology, including research contracts, investment fundings, exchange programmes, procurement.

The same question was asked for the Weizmann Institute and the Hebrew University of Jerusalem. No response was received for six months, until after the Information Commissioner had issued a decision notice threatening to take the university to the High Court for contempt of court.

The reply in September pointed out that:

We have undertaken a search to Faculty level within the University to identify Israeli institutions with whom we have a relationship other than those mentioned in your request, but have been unable to identify any. It is possible that information may be held by Schools, Research Groups or individual members of staff but to search to this level would not be possible within the time limit allowed by the Fees Regulations associated with the Freedom of Information Act.

The UoM provided a redacted document regarding the Hebrew University of Jerusalem (HUJ). It concerns a subcontract for the UoM to carry out work from 1 July 2015 to 30 June 2018 as part of a project awarded by Arthritis Research UK to the HUJ. The start date coincides with an award from Arthritis Research for research into cartilage repair. [1]

The University also supplied two redacted documents regarding the Weizmann Institute. One concerns a Collaboration Agreement between Weizmann and UoM, involving two unnamed researchers from the Dept. of Physics and Astronomy in a project anticipated to run from 1 Aug 2017 to 31 July 2018, although the contract allows it to extend to 31 July 2019 or longer by mutual agreement. The work is funded in US\$, with \$66,666 for Weizmann and \$33,333 for UoM. Unlike the other redacted documents, the funding body is not shown.

By coincidence, and perhaps unconnected, the “WEIZMANN UK MAKING CONNECTIONS AWARDS 2009 – 2018” [2] show just one project with Manchester for 2017-2018: Prof. Shalil Ilani and Prof. Eli Zeldov (Weizmann Institute of Science) and Prof. Andre K Geim (University of Manchester) *Visualizing Energy Dissipation in Strongly-Interacting Quantum Fluids*. Unlike other projects, no description is given. Shalil Ilani and Eli Zeldov work on nanoparticles. [3 4] A previous paper co-authored by Prof. Zeldov and Prof. Geim, entitled “Nanoscale thermal imaging of dissipation in quantum systems” [5] was partly funded through an EU Horizon 2020 grant titled “Ultra-sensitive Thermal Nanoscale Microscope”. [6]

The second redacted Weizmann document concerns supply of materials from the Weizmann Institute for use (targeted genomic analysis of single cells and bulk DNA) by Cancer Research UK Manchester Institute. The materials are coming from the Dept of Computer Science and Applied Mathematics, which may mean they are computer software for use in analyzing DNA. Yeda Research and Development Company [7] would benefit from any resulting inventions.

Technion

On Technion, the University only said “We have previously supplied you with a copy of the Memorandum of Understanding between the Technion Institute of Technology. There are no other centrally held contractual documents between The University of Manchester and this Institute.”

The Memorandum of Understanding, signed in 2013, was reported as concerning cooperation in stem cell and cancer research. [8] The document is an agreement “to explore educational and scientific cooperation efforts between the Faculties of Medical & Human Sciences and Life Sciences and the Ruth and Bruce Rappaport Faculty of Medicine, TECHNION.” It sets the framework for exchange visits and a confidentiality agreement, and encourages co-operative research. “The terms and conditions of any such agreement, including financial and intellectual property issues, will be determined in a separate agreement which will form an appendix to this MOU” [not included in the FOI response].

The UoM has conducted medical research with Technion in line with this Memorandum. But they have been involved in many other issues, not mentioned in the FoI response.

As discussed earlier, MULTIPROTECT was an EU funded project involving the UoM, IAI and Technion, and 3AS involved the UoM with Technion.

As part of the Graphene Flagship, two EU funded projects involve the UoM and Technion amongst many other institutions. GRAPHENE: “Graphene-Based Revolutions in ICT And Beyond” [9] ran from 2013-10-01 to 2016-03-31 with a total budget of €74,979,522 of which €54,000,000 was provided by the EU. UoM received €2,106,048 from the EU, and Technion €70,800, while Airbus had €59,998 and Thales €739,779 (see above for profiles of these arms firms).

GrapheneCore1: “Graphene-based disruptive technologies” [10] is a current project, running from 2016-04-01 to 2018-03-31, with a budget of €89,000,000 funded entirely by the EU. UoM received €4,552,485, Technion €94,000, Airbus €226,500 and Thales €964,250.

We do not know if any publications co-authored by UoM and Technion researchers have arisen or are in progress through either of these Graphene Flagship funding streams. However, another EU funded project did produce joint research.

TERAFLUX: “Exploiting dataflow parallelism in Teradevice Computing” ran from 2010-01-01 to 2014-03-31, with a budget of €8,207,282 including €6,120,000 from the EU, of which UoM received €765,444, along with MICROSOFT ISRAEL RESEARCH AND DEVELOPMENT 2002 LTD €220,236, Hewlett Packard (Spain) €50,499, and Thales €252,708. Whilst TERAFLUX did not fund Technion, the 2013 paper “The TERAFLUX Project: Exploiting the DataFlow Paradigm in Next Generation Teradevices” [11] was co-authored by Avi Mendelson (Technion), Daniel Goodman (UoM), Behran Khan (UoM), Mikel Luján (UoM), and Ian Watson (UoM), amongst others. Another co-author Antoniu Pop later joined the UoM. Prof. Avi Mendelson remains at Technion, Goodman was with the APT Advanced Processor Technologies Research Group at the UoM School of Computer Science but moved to Cambridge, the other UoM co-authors are all with the APT and Prof. Ian Watson is also on the Computer Science academic staff.

Bar-Ilan

Computer Science has also worked with Bar-Ilan University. There are 14 papers co-authored by Prof. Howard Barringer (UoM) and Prof. Dov Gabbay (Bar-Ilan), as identified through the DBLP Computer Science Bibliography database. [12] Another research paper, co-authored by Yingqing Zhang (Computer Science UoM) and Sarit Kraus (Bar-Ilan), was entitled “Approximation results for probabilistic survivability”. [13] It concerned Multiagent Systems, of which fleets of drones are an example. The paper was partly funded by the US Army Research Office, the US Army Research Laboratory, the Air Force Office of Scientific Research, and a subcontract from DARPA (Defense Advanced Research Projects Agency).

Conference

Shortly after Operation Cast Lead (the 2008-9 invasion of Gaza), the UoM hosted The First International Conference of Protective Structures 29 September – 1 October, 2010. [14]. Sponsors included Technion, the Ministry of Defence and DSTL (profiled earlier). The ICPS concerned “civil infrastructure protection against man-made and natural explosion and impact,” such as civil defence against rocket attack. It was chaired by Dr Qingming Li at UoM's School of Mechanical, Aerospace and Civil Engineering (MACE) and co-chaired by Prof. David Yankelevsky of Technion, while the International Scientific Committee for the conference included Prof. Avraham Dancygier (Technion) and Prof. Gabi Ben-Dor (Ben Gurion University of the Negev).

1 <http://www.arthritisresearchuk.org/research/grant-tracker-items/2015/investigating-the-role-of-sirt1-in-cartilage-repair.aspx>

2 <https://www.weizmann.org.uk/assets/site/documents/Making-Connections-Project-Summaries-Full-list-2018.pdf>

3 <http://www.ilanigroup.com/>

4 <https://www.weizmann.ac.il/condmat/superc/>

5 <https://www.nature.com/articles/nature19843>

6 https://cordis.europa.eu/project/rcn/195104_en.html

7 <http://www.yedarnd.com/>

8 <http://www.manchester.ac.uk/discover/news/article/?id=10457>

9 https://cordis.europa.eu/project/rcn/109691_en.html

10 https://cordis.europa.eu/project/rcn/200853_en.html

11 <http://ieeexplore.ieee.org/document/6628287/authors?ctx=authors>

12 <http://dblp.uni-trier.de/>

13 <http://www.cs.man.ac.uk/~zhangy/mass-approximation.pdf>

14 <http://www.iom3.org/sites/default/files/iom3-corp/2nd%20Announcement-ICPS2010.pdf>

UoM - Arms

Although this report has focused on the interplay with arms and Israel, there are other aspects of UoM involvement with the military. For example, the School of Mechanical, Aerospace and Civil Engineering has a webpage on Unmanned Aerial Systems [1]:

As one of the largest UAS research centres in the UK we have extensive experience in all aspects of automated flying systems, and their use for both scientific and commercial problems. Our current portfolio includes photogrammetry, thermal sensing, and environmental modelling and monitoring.

It mentions funding from BAE and refers to the GAMMA programme as “Using UAS facilities to support development of software solutions for managing autonomous systems.”

There is also a GAMMA webpage within the MACE site, [2] whose News section explains that

“GAMMA (Growing Autonomous Systems Mission Management Applications) is a technology and next generation supply chain development programme led by North West Aerospace Alliance in partnership with BAE Systems and North West Universities Manchester. Liverpool, Lancaster, Salford, Central Lancashire and the National Nuclear Laboratories.”

More details can be recovered via the Wayback Machine (internet archive). The roles of UoM and the University of Liverpool are detailed, [3] for example concerning Sensors.

Multi-Sensor Fusion (University of Manchester)

...the University of Manchester is primed to provide a platform that facilitates sensor integration, while supporting the entire GAMMA programme with a rich repertoire of knowledge on every aspect of the sensor and control theme...

The University of Manchester, particularly School of EEE [Electronic and Electrical Engineering], has developed the mission management hardware board RedCape to continuously provide the world-class expertise and support in UAV multisensor integration and control...

One of the sensor systems integrated in Manchester was being developed in Liverpool:

Wide Field of View sensor systems, allow persistent, continuous video surveillance of an entire town or city (approximately a 6km diameter area on the ground). These systems produce vast quantities of image data, that needs to be reduced down to metadata and regions of interest before transmission. Simulation of such a sensor allows it to be quickly positioned in a scene without the need to access and fly the sensor. Ground traffic can be controlled and suspicious vehicles added. The University of Liverpool can generate visually consistent and detailed Wide Field-of-View imagery using one or more instances of a COTS (Commercial Off The Shelf) flight simulator, and a traffic simulator to create thousands of persistent targets in the world. Approximating the specifications of the BAe/DARPA ARGUS-IS sensor.

As mentioned earlier, DARPA is the Defense Advanced Research Projects Agency, part of the US Department of Defense. ARGUS-IS, an acronym for Autonomous Real-Time Ground Ubiquitous Surveillance Imaging System, is a DARPA project awarded to BAE Systems. [4] Users can collect "pattern-of-life" data and track individual people inside the video footage. As ARGUS floats overhead for months, it dragnet tracks every moving person and vehicle, allowing investigators to rewind and watch the activities of anyone they select. ARGUS-IS has been incorporated in the MQ-9 Reaper hunter-killer drones deployed over Syria and Iraq by the US and UK.

In plain English, this is the technology of targeted assassination, contracted to BAE by DARPA for the US Department of Defense. When the GAMMA programme was launched, the University of Liverpool press release on 21 Nov 2012 [5] showed an photo of an unidentified plane:

£9.1M autonomous systems project launched



Autonomous systems are technology based solutions that replace humans in tasks that are mundane, dangerous and dirty, or detailed and precise

A 2010 BBC news report “MoD lifts lid on unmanned combat plane prototype” used the same image, credited to the MoD. [6] The BBC used it again in 2014, now credited to BAE Systems, in a report entitled “Top secret UK drone Taranis makes first flight”. [7]

Taranis is the most advanced UK aircraft ever designed. It is a £185m prototype Unmanned Combat Aerial Vehicle, produced by the MoD with BAE Systems, Rolls-Royce, GE Aviation and QinetiQ. Using the photo in the Liverpool press release on the launch of the GAMMA programme, involving BAE, suggests that the systems developed in Liverpool and Manchester, including Wide Field of View sensor systems approximating the specifications of the BAe/DARPA ARGUS-IS sensor, were intended for Taranis.

1 <http://www.mace.manchester.ac.uk/our-research/facilities/unmanned-aerial-systems/>

2 <http://gamma.manchester.ac.uk/>

3 <https://web.archive.org/web/20160607133815/http://gammaprogramme.co.uk:80/gamma-heis/>

4 <https://en.wikipedia.org/wiki/ARGUS-IS>

5 <https://news.liverpool.ac.uk/2012/11/21/9-1m-autonomous-systems-project-launched/>

6 <http://www.bbc.co.uk/news/10602105>

7 <http://www.bbc.co.uk/news/uk-26046696>

Conclusion

In mid March, the University announced a Graphene Aerospace Strategy [1 2] formulated by the Aerospace Technology Institute (ATI) and the National Graphene Institute. Lead partners for ATI projects [3] include BAE Systems, Thales UK, Airbus, GE Aviation, Qinetiq – arms firms trading with Israel. The Strategy also refers explicitly to potential roles for graphene including composite materials and electrical propulsion as discussed above.

The commercialisation of the University, as apparent in this report, is neither new nor unique to Manchester. As Chris Langley of Scientists for Global Responsibility wrote in “*Soldiers in the Laboratory*” in 2005: [4]

A variety of complex and interlocking changes which have occurred in the UK and elsewhere in the industrialised world in the last fifteen to twenty years have set the stage for the privatised university. Here research portfolios are increasingly dominated by industrial liaison of various kinds and commercial agendas are often imported wholesale into the university domain...

Many would argue that increased reliance on industry; the redirection of research effort towards practical or applied subjects in both teaching and research; the proprietary treatment of research outcome with commercial interest in secrecy overriding the public interest in free, accessible and shared knowledge; all compromise ‘academic freedom’...

We hope that this report will provoke a debate with some facts on the table, and that more will emerge. We call on students, staff and their unions to consider the implications of the University continuing on its current path, and to address the questions posed in the Introduction to this Report. We think that ending the involvement with the arms trade and the Israeli military is long overdue.

We hope that students and staff will consider working with the University of Manchester Boycott, Divestment & Sanctions campaign, [5] which actively works alongside Manchester Palestine Action [6] and Manchester Palestine Solidarity Campaign. [7] All of us campaign in support of the Palestinian Civil Society Call, first issued on 9th July 2005 and endorsed by around 200 Palestinian organisations, for Boycott, Divestment and Sanctions against Israel Until it Complies with International Law and Universal Principles of Human Rights. [8]

At the same time, the University could begin to redirect its efforts towards socially useful production and alternative industrial strategies. Some ideas are outlined in the Conclusions of the Liverpool pamphlet “Get Your Bombs Off Our Lawn”. [9] Others are thinking about these issues as well. We recommend reading and contacting Scientists for Global Responsibility, [10] Campaign Against Arms Trade, [11] and War On Want. [12]

Proposed Demands

As a starting point for discussion with other solidarity activists, we propose that the following demands on the University could form the basis for campaigning:

- 1) The University will refrain from any cooperation in military or security fields with Israeli academic, State or industrial organisations, while Israel continues to defy UN Security Council resolutions and international law including the 4th Geneva Convention.
- 2) The University will end investment, commercial and research collaboration with Versarien and its subsidiaries, in view of Versarien’s contract with Israel Aerospace Industries, which draws directly on research at the University of Manchester.

- 3) The University will adopt and implement policies of complete transparency over past, present and future research projects, so that their implications can be considered in full.
- 4) The University will put no pressure on students to carry out research projects involving the arms industry, and will offer alternatives.
- 5) The University will commit significant resources to exploring and developing alternative industrial strategies in conjunction with trade unions and relevant experts, to end the University's reliance on the arms industry and to develop socially useful production.

- [1] <http://www.manchester.ac.uk/discover/news/graphene-aerospace-strategy-launched/>
- [2] http://www.ati.org.uk/wp-content/uploads/2017/02/ATI-INSIGHT_06-Graphene-Exploitation_materials-applications-in-aerospace.pdf
- [3] <http://www.ati.org.uk/portfolio/projects/>
- [4] http://www.sgr.org.uk/ArmsControl/Soldiers_in_Lab_Report.pdf
- [5] <https://manchesterstudentsunion.com/groups/boycott-divestment-sanctions>
- [6] <https://www.manchesterpalestineaction.org/>
- [7] <http://www.psc-manchester.org.uk/>
- [8] <https://bdsmovement.net/call>
- [9] <http://www.labournet.net/other/1510/livarmsall.pdf>
- [10] <http://www.sgr.org.uk/>
- [11] <https://www.caat.org.uk/>
- [12] <https://waronwant.org/>