



Technological ambiguity in export controls: a tool for legitimacy?

Samuel A. Evans, DPhil

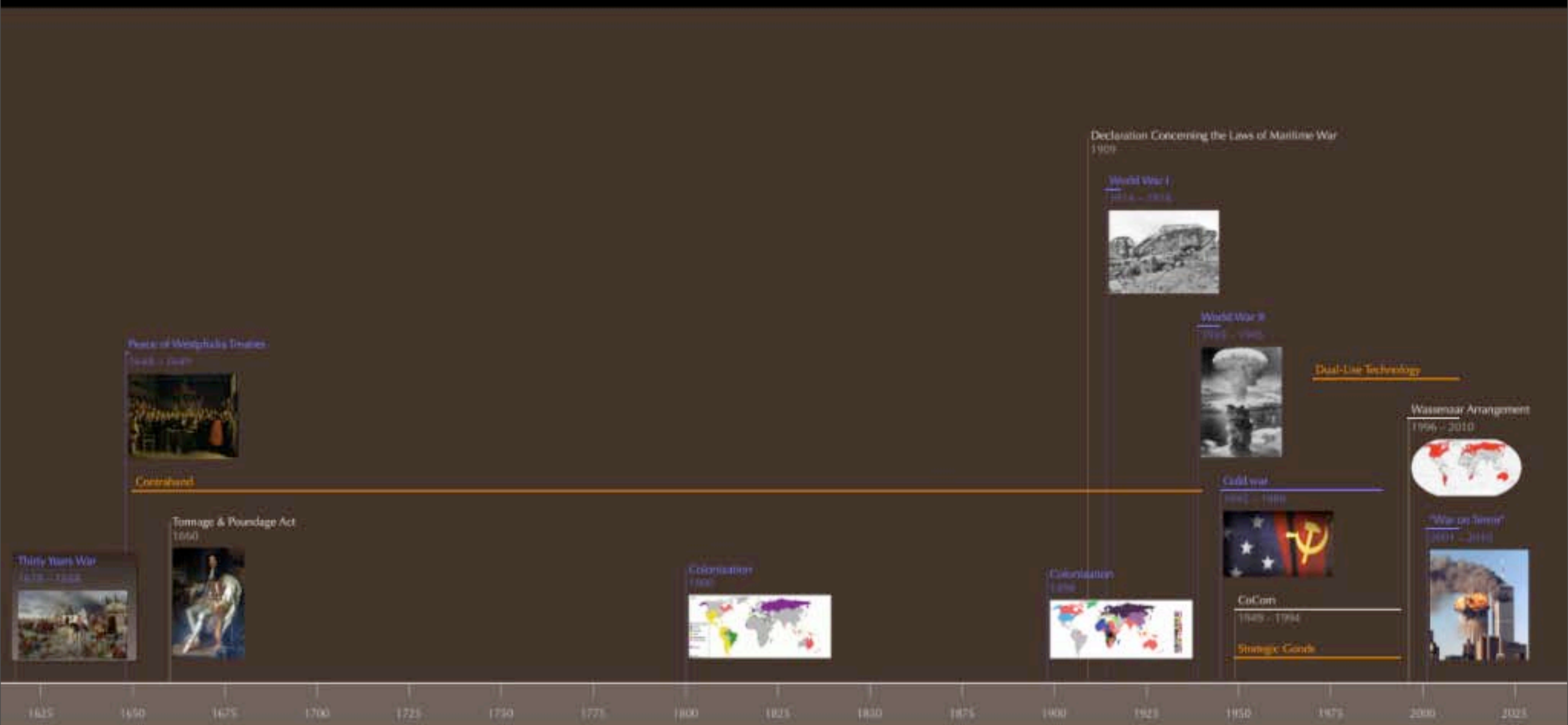
Program on Science, Technology, & Society (HKS) and
School of Engineering & Applied Sciences
Harvard University

*Presentation to the Peace Studies Program and
Dept. of Science & Technology Studies, Cornell University
11 March 2010*

Introduction

- Analyzing the three classification systems used (to try) to control distribution of the means of destruction of society over the last 400 years
- Each classification system built to address two types of ambiguity:
 - Ambiguity in how to know what items needed to be controlled
 - Ambiguity in who is responsible for controls
- The inability to resolve ambiguity in one type affects the other
- Each classification system is therefore a tool for constructing both the material/technical and the social world

Historical contexts of classification systems





Contraband

Tonnage & Poudage Act
1660

Thirty Years War

1618 – 1648



1625

1650

1675

1700

1725

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1775

1800

1825

1850

1875

1900

1925

1950

Peace of Westphalia Treaties

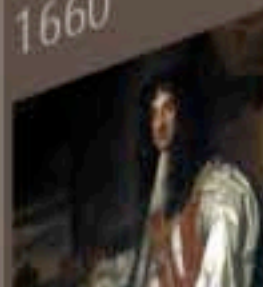
1648 – 1649



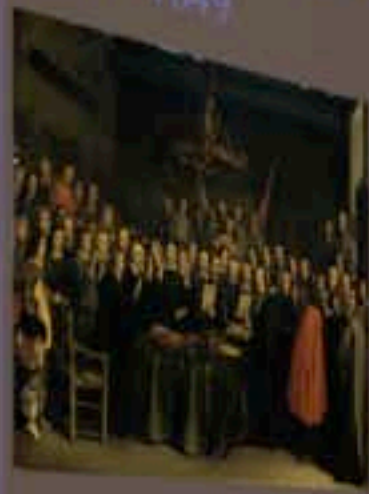
Contraband

Tonnage & Poundage Act

1660



Peace of Westphalia Treaties
1648 - 1649



Contraband

Tonnage & Poundage Act
1660



Thirty Years War
1618 - 1648



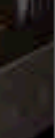
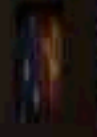
1700

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1800



Thirty Years War 1618 – 1648



Contraband

Tonnage & POUNDAGE Act 1660



1625

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Colonization 1800



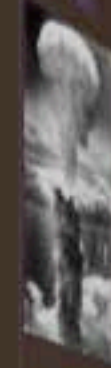
Colonization 1900



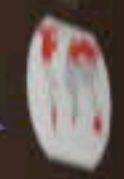
CoCon 1948 - 1994

Orange Coast

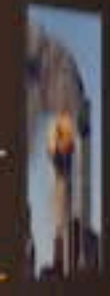
World War I
1914 - 1918



World War II
1939 - 1945



Space Race
1955 - 1960



1875

1900

1925

1950

1975

2000

2025

Colonization

1898



Dual-Use Technology

Cold war

1945 - 1989



Weapons Arrangement

1996 - 2010



'War on Terror'

2001 - 2010



Declaration Concerning the Laws of Maritime War 1909

World War I
1914 – 1918



World War II
1939 – 1945

Technology

Arrangement

Declaration Concerning the Laws of Maritime War
1909

World War I

1914 – 1918



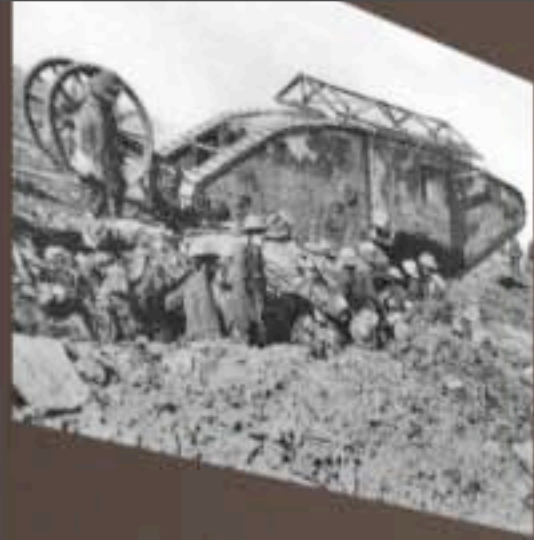
World War II
1939 – 1945



Dual-Use Technology

Wassenaar Arrangement
1996 – 2010





World War II 1939 – 1945



Technology

Wassenaar Arrangement 1996 – 2010



Cold war 1945 – 1989



"War on Terror" 2001 – 2010



Colonization
198



Dual-Use Technology

Wassenaar Arrangement
1996 - 2010



Cold war
1945 - 1989



on Terror'
2010



CoCom
1949 - 1994

Strategic Goods

1975 2000 2025

Colonization 1898



Cold war 1945 - 1989



CoCom

1949 - 1994

Strategic Goods

Wassenaar Arrangement 1996 - 2010



"War on Terror" 2001 - 2010



1900

1925

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Colonization
1898



Cold war
1945 – 1989



CoCom
1949 – 1994

Strategic Goods

Wassenaar Arrangement
1996 – 2010



'War on Terror'
2001 – 2010



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World War II
1939 – 1945



Dual-Use Technology

Wassenaar Arrangement
1996 – 2010



Cold war
1945 – 1989



"War on Terror"
2001 – 2010



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Dual-Use Technology

Wassenaar Arrangement
1996 – 2010



War
– 1989



"War on Terror"
2001 – 2010



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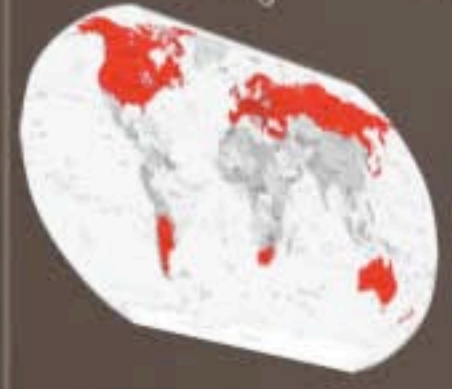
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– 1994

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1975

Assenaar Arrangement
1996 – 2010



"War on Terror"

2001 – 2010



2000

2025

Structure of Analysis

1. What is the defining principle used to resolve ambiguity in the items to be controlled?
2. Who has responsibility for controlling the distribution of the means of destruction?
3. How did material/technological ambiguity come back in (or never completely resolve)?
 - How did material/technological ambiguity constrain social order?
4. How did ambiguity in responsibility come back in (or never completely resolve)?
 - How did social order constrain the usefulness of the technical order?



An Early Sailing Ship 1850's by Gordon Grant



The Ratification of the Treaty of Munster, Gerard Ter Borch (1648)

Contraband

1660 - Tonnage and Poundage Act
1909 - Declaration Concerning the Laws
of Maritime War

Contraband

What is the defining principle used to resolve ambiguity in the items to be controlled?

- Grotius (1625): contraband are goods transferred in times of war
- What counts as contraband?
 - Use (war or peace?)
 - Physical characteristics

“The classification of goods as contraband or not contraband has much perplexed text writers and jurists. *A strictly accurate and satisfactory classification is perhaps impracticable*; but that which is best supported by American and English decisions may be said to divide all merchandise into *three classes*. Of these classes, the first consists of *articles manufactured and primarily and ordinarily used for military purposes in time of war*; the second, of *articles which may be and are used for purposes of war or peace*, according to circumstances; and the third, of *articles exclusively used for peaceful purposes*. Merchandise of the first class, destined to a belligerent country or places occupied by the army or navy of a belligerent, is always contraband; merchandise of the second class is contraband only when actually destined to the military or naval use of a belligerent; while merchandise of the third class is not contraband at all, though liable to seizure and condemnation for violation of blockade or siege.”

US Supreme Court, 5 Wallace 28 ¶136
(1866)

Who has responsibility for controlling the distribution of the means of destruction?

The King is Sovereign

Thirty Years War
Treaties of Westphalia



Tonnage & Poundage Act, 1660

“Gunpowder when the same doth not exceed the price of five pounds the Barrel.”

“Provided always, That it shall be free and lawful for His Majesty at any time, when he shall see cause so to do; and for such time as shall be therein expelled, by Proclamation to prohibit the Transporting of Gunpowder, or any sort of Arms or Ammunition, into any parts out of this Kingdom...”

10 Anno XII. CAROLI II. Regis.
person or persons, to ship, carry out, and transport by way of Merchandize; these several sorts of Goods following; that is to say, Gunpowder when the same doth not exceed the price of five pounds the Barrel. And Wheat, Rye, Pease, Beans, Barley, Mault and Oats, Pork, Bacon, Butter, Cheese, Candles, when the same do not exceed in price at the Ports from whence they are Laden; and at the time of their Lading these prices following, that is to say, Wheat, the Quarter forty shillings; Rye, Beans and Pease, the Quarter, Twenty four shillings; Barley and Mault, the Quarter Twenty shillings; Oats, the Quarter Sixteen shillings; Beef, the Barrel five pounds; Pork, the Barrel six pounds ten shillings; Bacon, the Pound six pence; Butter, the Barrel four pounds ten shillings; Cheese, the hundred One pound ten shillings; Candles, the Dozen pound five shillings, paying the respective Rates appointed by this Act, and no more, Any former Law, Statute, Prohibition or Custom to the contrary in any wise notwithstanding.

Provided always, That it shall be free and lawful for His Majesty at any time, when he shall see cause so to do; and for such time as shall be therein expressed, by Proclamation to prohibit the Transporting of Gunpowder, or any sort of Arms or Ammunition, into any parts out of this Kingdom, Any thing in this Act contained to the contrary notwithstanding.

And be it further Enacted by the Authority aforesaid; That over and above the Rates herein beforementioned, there shall be paid unto Your Majesty of every Tun of Wine

Material ambiguity reenters

- “Use” hard to determine
- Controls in effect only in times of war
- Hague Peace Conferences of 1899 & 1907

“That the **progress of science** has increased the number of things which in certain circumstances are of use in war though not absolute contraband in the strictest sense---that the complaints of neutrals on account of **interference with the trade** in things of that class have consequently increased---that the complexity of the cargoes carried by modern merchantmen of large size makes the **search** in them for contraband goods **difficult and vexatious**---that further difficulties would arise if a ship accused of carrying contraband was allowed to proceed on her voyage, the alleged contraband being **transhipped** or destroyed---that the **destination** of contraband to the enemy is often **difficult of proof**, and that under the doctrine of continuous voyage a belligerent **might almost entirely interrupt neutral commerce**---that for all these reasons the principle of contraband is the source of great damage to trade in non-contraband goods, and that neutrals demand indemnities so large that prize courts refuse them... and that **to abandon it would be a work of peace and justice.**”

Westlake (1913, p. 288)

How did material ambiguity come back in?

1909 Declaration Concerning the Laws of Maritime War

Conditional contraband list

ARTICLE 24

The following articles, susceptible of use in war as well as for purposes of peace, may, without notice,¹ be treated as contraband of war, under the name of conditional contraband:

- (1) Foodstuffs.
- (2) Forage and grain, suitable for feeding animals.
- (3) Clothing, fabrics for clothing, and boots and shoes, suitable for use in war.
- (4) Gold and silver in coin or bullion; paper money.
- (5) Vehicles of all kinds available for use in war, and their component parts.
- (6) Vessels, craft, and boats of all kinds; floating docks, parts of docks and their component parts.
- (7) Railway material, both fixed and rolling-stock, and material for telegraphs, wireless telegraphs, and telephones.
- (8) Balloons and flying machines and their distinctive component parts, together with accessories and articles recognizable as intended for use in connection with balloons and flying machines.
- (9) Fuel; lubricants.
- (10) Powder and explosives not specially prepared for use in war.
- (11) Barbed wire and implements for fixing and cutting the same.
- (12) Horseshoes and shoeing materials.
- (13) Harness and saddlery.
- (14) Field glasses, telescopes, chronometers, and all kinds of nautical instruments.

1909 Declaration Concerning the Laws of Maritime War

Free list

ARTICLE 28

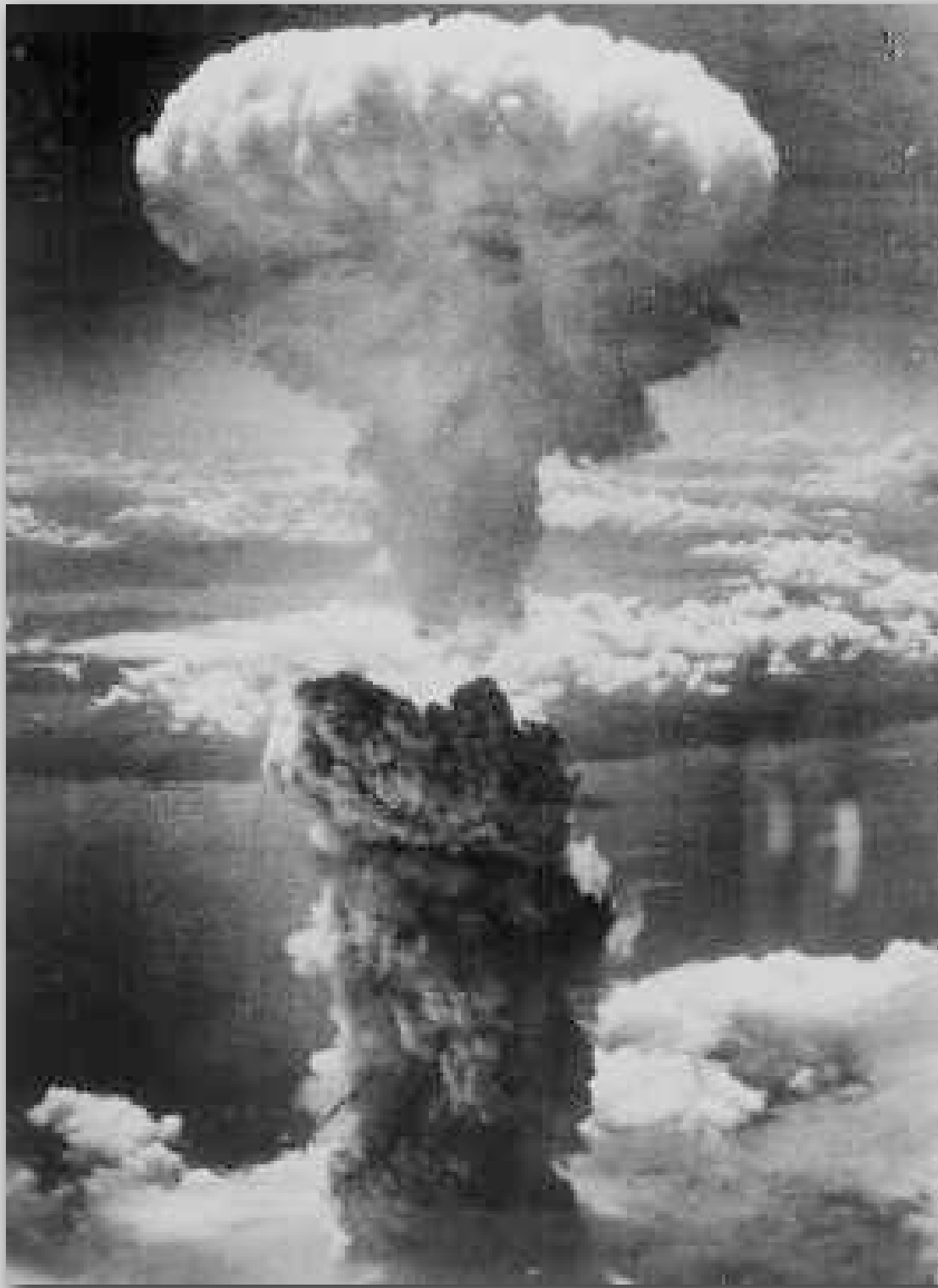
The following may not be declared contraband of war :

- (1) Raw cotton, wool, silk, jute, flax, hemp, and other raw materials of the textile industries, and yarns of the same.
- (2) Oil seeds and nuts ; copra.
- (3) Rubber, resins, gums, and lacs ; hops.
- (4) Raw hides and horns, bones and ivory.
- (5) Natural and artificial manures, including nitrates and phosphates for agricultural purposes.
- (6) Metallic ores.
- (7) Earths, clays, lime, chalk, stone, including marble, bricks, slates, and tiles.
- (8) Chinaware and glass.
- (9) Paper and paper-making materials.
- (10) Soap, paint and colors, including articles exclusively used in their manufacture, and varnish.
- (11) Bleaching powder, soda ash, caustic soda, salt cake, ammonia, sulphate of ammonia, and sulphate of copper.
- (12) Agricultural, mining, textile, and printing machinery.
- (13) Precious and semi-precious stones, pearls, mother-of-pearl, and coral.
- (14) Clocks and watches, other than chronometers.
- (15) Fashion and fancy goods.
- (16) Feathers of all kinds, hairs, and bristles.
- (17) Articles of household furniture and decoration ; office furniture and requisites.

ARTICLE 29

Likewise the following may not be treated as contraband of war :

- (1) Articles serving exclusively to aid the sick and wounded. They can, however, in case of urgent military necessity and subject to the payment of compensation, be requisitioned, if their destination is that specified in Article 30.
- (2) Articles intended for the use of the vessel in which they are found, as well as those intended for the use of her crew and passengers during the voyage.



How did ambiguity in responsibility come back in?



Strategic Goods

CoCom Lists

Who has responsibility for controlling the distribution of the means of destruction?



CoCoM



■ Nato ■ Warschauer Pak

What is the defining principle used to resolve ambiguity in the items to be controlled?

Strategic Goods

- Possible to dissociate between “us” and “them”
- Possible to control all transfers of strategic goods
- Possible to define all of the goods to be controlled

Early CoCom Lists

- Much more extensive (8 pages in 1954)
- Embargo/quantitative limits
- Alphabetical lists of technologies

Trade With the Soviet Bloc: Lists of Goods Controlled for Strategic Reasons

ON July 26, the President of the Board of Trade announced in the House of Commons that, following consultations with other countries, agreement had been reached on a reduction of the lists of goods other than ships, the export of which to the Soviet Bloc (as distinct from China) is controlled for strategic reasons. Certain problems of definition had still, however, to be worked out.

Although one or two definitions have yet to be settled, it is now possible to publish below the new lists of the items, other than ships, the export of which is controlled by the United Kingdom for strategic reasons and which may not, therefore, be exported to the Soviet Bloc countries without approval.

The general effect of the revised controls is to reduce the embargo list by about 80 items, and the quantitative control list by about 70 items and to enlarge the area of permitted trade in a large number of categories remaining under control. Examples of the last include general purpose machine tools, electric generating plant, locomotives and railway equipment, chemicals and chemical plant.

List I shows the goods which are subject to embargo and List II the items which are subject to quantitative limits.

For the convenience of traders List I includes the munitions and atomic energy items which have for several years been subject to embargo in the United Kingdom. These goods were outside the scope of the President's announcement on July 26. The number of items in List I is accordingly greater than that mentioned by the President.

For technical reasons and in order to facilitate matters for traders, some of the definitions used differ slightly from those agreed by the Co-ordinating Committee on East-West Trade. In no case, however, do the amended definitions alter the scope of the controls agreed by the Co-ordinating Committee.

Most of the necessary changes in export licensing are brought about by the Export of Goods (Control) (Amendment No. 2) Order, 1954—see page 788 of this issue.

Exporters should address any inquiries concerning these lists either to the Board of Trade, Commercial Relations and Exports Department, Horse Guards Avenue, London, S.W.1 (from which further copies of the lists may be obtained) or to the Production department for the item concerned. Applications for export licences or for further information on the types of goods for which an export licence is required should be addressed to the Board of Trade, Export Licensing Branch, Atlantic House, Holborn Viaduct, London, E.C.1.

List I

Group A

Apparatus designed for removing surplus stock from workpieces of metal or other materials :—

- (a) by the discharge of electric sparks from a shaped electrode, or
- (b) by applying ultrasonic vibrations, or
- (c) by electrolytic means in combination with abrasive action.

Machines and apparatus specially designed for making or measuring gas turbine blades.

Machines, Metalworking, not elsewhere specified, the following :—

Boring and turning mills, vertical, the following :—

Automatic cycle types.

Types, other than automatic cycle, with table diameter over 96 inches.

Deep hole drilling machines in which the coolant passes through the drill.

External surface broaching machines.

Forging hammers, the following :—

Gravity hammers having a falling weight of over six tons.

Steam, air or mechanical hammers of rated size over five tons.

Gear cutting machines, other than hobbing machines of 48 inches maximum work diameter or less.

Grinding machines, the following :—

Auto cycle, auto sizing grinding machines for broaching tools.

Automatic oscillating race track grinding machines.

Contour profile grinding machines.

Disc grinding machines, multi-spindle.

Gear grinding machines, generating types.

Internal grinding machines incorporating high frequency (over 60 cycles) spindles.

Jig grinding machines.

Roll grinding machines.

Surface grinding machines, horizontal spindle, rectangular reciprocating table greater than 24 inches wide.

Surface grinding machines, multi-spindle, rotary table.

Thread grinding machines.

Honing machines, multi-station.

Jig boring machines.

Lathes, the following :—

Centre lathes exceeding 18 inches centre height and exceeding 18 feet between centres.

Combination tube boring and turning lathes.

Multi-spindle automatic lathes.

Right-angle T lathes.

Spinning lathes designed for use with or equipped with spindle drive motor exceeding 10 h.p.

Turret lathes of 4 inches bar capacity and over or swing-over-bed of 24 inches or over.

Machinery for drawing and tempering wire 0.015 inch in diameter or less or tubing 0.026 inch in diameter or less.

Milling and planing machines, the following :—

Armour plate planing machines.

Milling machines having a travelling head or heads, capable of milling aircraft spars.

Planing machines, plano-milling machines, combination planing and milling machines with capacity for workpieces 6 feet wide or over or 20 feet long or over.

Thread milling machines, 6 inches thread diameter and over.

Presses, hydraulic and mechanical, of an effective operating pressure of over 1,000 tons.

Profiling, copying and duplicating machines.

Machines specially designed for the working or forming of aircraft sheet, aircraft plate or aircraft extrusions.

Machine tool parts and accessories, the following :—

Accessories, for attachment to metal working machine tools, designed to render such machine tools capable of the automatic reproduction or duplication of a model, template or pattern (other than taper turning attachments).

High frequency spindles (over 60 cycles) and assemblies thereof for internal grinding machines.

Metal cutting and working tools, not incorporating diamonds, for machine operations, the following :—

Deep hole drills of the type in which a hardened steel or hard metal cutting piece is fixed into a tubular shank.

Surface broaching.

Group B

[In this group a specified corrosion-resistant material means polytetrafluoroethylene, polytrifluorochloroethylene, or a material containing :—

(i) 90 per cent. or more tantalum, titanium or zirconium, either separately or combined, or

(ii) 50 per cent. or more cobalt or molybdenum, either separately or combined, or

(iii) 10 per cent. or more silicon (as metal alloy).]

Blowers and compressors (turbo, centrifugal and axial-flow types), wholly made of or lined with aluminium, nickel or alloy containing 60 per cent. or more nickel.

Carbon black furnaces, controlled atmosphere type, intermittent or continuous.

Centrifugal counter-current solvent extractors.

Centrifuges, with a peripheral speed of 1,000 feet per second or more, wholly made of or lined with aluminium, nickel or alloy containing 60 per cent. or more nickel; and centrifugal bowls made of these materials.

Compressors, not elsewhere specified, of 300 b.h.p. or more, capable of delivering air, gases or vapours at pressures exceeding 450 p.s.i.g.

Dielectric driers for bacteriological materials.

Electrolytic cells for the production of fluorine.

Equipment for the production of hydrogen and deuterium oxide, the following :—

Complete installations capable of producing hydrogen by the electrolytic process at a rate of 30,000 cu. ft. or more per hour;

Electrolytic cells for the production of hydrogen at a rate of 60 cu. ft. or more per hour;

Equipment for the production or concentration of deuterium oxide.

Equipment for the production of lubricants (petroleum based or synthetic), the following :—

Dewaxing units, including centrifugal and solvent dewaxing units;

Filtration units, including percolation filtration, contact filtration, and filter fractionation units;

Fractionating, rectifying, and dephlegmating columns, and parts specially designed therefor;

(Continued on next page)

How did technological ambiguity come back in?

Late CoCom Lists

- Size ballooned to over 100pgs
- Problems:
 - antiquated numbering/
grouping system
 - difficult to remove items
 - shift from embargo to
cooperation led to trade
stresses on lists

Consolidated list
of goods subject to

Security export control

March 1990

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INDUSTRIAL LIST — GROUP 3		MUNITIONS LIST — GROUP 1	
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Computers

- Originally simple control

(v) employing accelerating potentials in excess of 5,000 volts, and parts and accessories specially designed therefor.
Amplifiers which are accessories or sub-assemblies specially designed for the cathode ray oscilloscopes specified in (i) above.
Computers, electronic, other than office calculating machines.
Cyclotrons, belt-type electrostatic generators (Van de Graaff machines), synchro-cyclotrons, betatrons, synchrotrons, linear accelerators and other electronuclear machines capable of imparting energies greater than 1,000,000 electron volts to a nuclear particle or an ion, and magnets specially designed for such electronuclear machines.

Trade with the Soviet Bloc—(Continued)

- (i) incorporating amplifiers with a bandwidth (defined as the band of frequencies over which the power amplification does not drop to less than one-half of its maximum value) greater than 5 megacycles, or
- (ii) having a time base shorter than 0.05 microseconds per centimetre, or
- (iii) incorporating, or designed to use cathode ray tubes with more than one electron gun, or
- (iv) incorporating three or more cathode ray tubes, or
- (v) employing accelerating potentials in excess of 5,000 volts, and parts and accessories specially designed therefor.
- Amplifiers which are accessories or sub-assemblies specially designed for the cathode ray oscilloscopes specified in (i) above.
- Computers, electronic, other than office calculating machines.
- Cyclotrons, belt-type electrostatic generators (Van de Graaff machines), synchro-cyclotrons, betatrons, synchrotrons, linear accelerators and other electronuclear machines capable of imparting energies greater than 1,000,000 electron volts to a nuclear particle or an ion, and magnets specially designed for such electronuclear machines.
- Electron microscopes and electron guns and electron objective, projection and condenser lenses (magnetic or electrostatic) therefor.
- (c) Infra-red types, having an effective total prism base length over 2 inches;
- (d) Recording or controlling densitometers or other equipment specially designed for the quantitative assessment of spectrographic records, except:—
- (i) instruments limited to the use of replica plane gratings not exceeding 1 inch in ruled width, and gratings therefor,
- (ii) instruments of the "circle" type incapable of direct measurement to less than 5 seconds of arc.
- Valve voltmeters (other than voltmeters specially designed for testing telephone lines) of the following descriptions:—
- (a) Direct-current voltmeters with full-scale range of 1 millivolt or less;
- (b) Alternating-current voltmeters with full-scale range of 10 microvolts or less.
- X-ray and electron diffraction apparatus, the following:—
- Electron diffraction units and parts specially designed therefor.
- Powder cameras of the type having a heating element for temperatures of 500° C. (932° F.) or over;
- Single crystal oscillating and rotating X-ray goniometers of the kind having X-ray film or plate holders;
- X-ray diffraction units, incorporating or designed for use with such

- Ionization chambers;
- Ionization measuring equipment suitable for the radiation survey of terrain and plant sites;
- Neutron counters containing boron, boron trifluoride, or hydrogen;
- Electron multiplier units activated by positive ions;
- Quenching units for Geiger-Muller counters;
- Resistors of resistance of not less than 1,000 megohms;
- Scaling units and rate meters, suitable for use in radiation detection;
- Scintillation counters incorporating a photomultiplier tube;
- Scintillation counter phosphors, the following: single crystals and scintillation phosphors for use in radiation detection instruments, of volume greater than 1 cu. in. (16 cu. cm.);
- Valves (tubes), electrometer, designed to handle input currents less than 1 micro-microampere.
- Resistors, temperature-sensitive, of a kind used in bolometers or in the measurement of electric power below 10 milliwatts (other than electric lamps).
- Spectrographs, spectrometers, monochrometers and associated measuring equipment of the following descriptions:—
- (a) Grating types with, or designed for use with, diffraction gratings (originals or replicas, plane or concave) and gratings therefor;
- (b) Prism types:—
- (i) capable of a spectrum length of 20 cms. between 9,000 and 2,000 Angstrom units, or
- (ii) designed for use with prisms having refracting face 35 mm. or more in width;
- (c) 6 per cent. or more of cobalt;
- (d) 0.25 per cent. or more of columbium (niobium) or tantalum;
- (e) 35 per cent. or more of nickel;
- (f) 35 per cent. or more of alloying elements (other than one of which is nickel).
- Aluminum alloys containing by weight one or more of the following constituents:—
- (a) 1 per cent. or more of copper;
- (b) 4 per cent. or more of zinc;
- (c) 3.5 per cent. or more of silicon;
- (d) 9.5 per cent. or more of magnesium.
- Aluminum powder, not elsewhere specified, other than polished disc.
- Beryllium and alloys containing by weight more than 50 per cent. of beryllium, other than windows for medical X-ray machines.
- Cobalt.
- Columbium (niobium) and alloys containing by weight 50 per cent. or more of columbium.
- Copper and alloys containing by weight 50 per cent. or more of copper (other than wire, drawn or extruded, bare, whether stranded or not, including cables, ropes and spirals).
- Germanium.
- Magnesium alloys containing by weight one or more of the following constituents:—
- (a) 0.4 per cent. or more of zirconium;
- (b) 1.5 per cent. or more of thorium;
- (Continued on next page)

- (c) indirectly heated valves of a kind that can be passed through a circular hole of 7.2 mm in diameter;
- (d) valves designed to withstand acceleration of short duration (shock) greater than 1,000 g;
- (e) valves designed for operation in ambient temperatures exceeding 100° centigrade;
- (f) vacuum tubes specially designed for use as pulse modulators for radar or for similar applications, having a peak anode voltage rating of 100 kilovolts or more; or rated for a peak pulse power of 2 megawatts or more.

1559. Hydrogen thyratrons, as follows:
 (a) rated for a peak pulse power output of 2 megawatts or more; or
 (b) of metal-ceramic construction.
 Technical Note: A thyatron is any hot cathode gas-filled tube containing 3 or more electrodes in which anode current flow is initiated by a control electrode.
 Equipment described in sub-item (b).

1560. Components and parts used as inductive and capacitive elements in electronic circuits, designed for and/or capable of reliable performance in relation to their electrical and mechanical characteristics and maintaining their design service lifetime while operating:
 (a) over the whole range of ambient temperatures from below -45° centigrade to above +100° centigrade; or
 (b) at ambient temperatures of 200° centigrade or higher.
 Explanatory Note: Included in this definition are such items as capacitors, transformers, chokes, relays, etc.

1561. Materials specially designed and manufactured for use as absorbers of electromagnetic waves having frequencies greater than 2×10^7 cycles per second, and less than 3×10^{11} cycles per second.

1562. Tantalum and niobium electrolytic capacitors as follows:
 (a) All types designed to operate permanently at temperatures exceeding 85° centigrade;
 (b) sintered electrolytic capacitors, except those having a casing made of epoxy resin or sealed with epoxy resin;
 (c) Electrolytic capacitors constructed with foils.

1564. Electronic components, as follows:
 (a) Assemblies and sub-assemblies constituting one or more functional circuits with a component density greater than 75 parts per cubic inch (4.575 parts per cubic centimetre);
 (b) Modular insulator panels (including wafers) mounting single or multiple electronic elements and specialized parts therefor.

Technical Note: Circuit boards and panels which do not contain components described in this list and which do not come within the scope of sub-item (a) above are not covered by sub-item (b) unless they are constructed of insulating materials other than paper base phenolics, glass cloth melamine, glass cloth epoxy resin or of insulating materials with an operating temperature range not exceeding that of the above-mentioned materials.

(c) Integrated circuits, i.e. assemblies and sub-assemblies containing one or more functional circuits in which there are both components and inter-connections formed by the diffusion or deposition of materials into or on a common substrate.
 Devices described in sub-items (a), (b), (c), provided that the devices have been designed specifically for identifiable civil applications and, by nature of design or performance, are substantially restricted to the particular application for which they have been designed.

Group G. Scientific Instruments and Apparatus, Servomechanism and Photographic Equipment

1565. Electronic computers and related equipment as follows:
 (a) Analogue computers with one or more of the following characteristics:
 (i) Rated errors less than:
 (a) Summers, inverters and integrators:
 (1) Static: 0.02 per cent
 (2) Total at 1 kilohertz 0.15 per cent
 (ii) Multipliers:
 (1) Static: 0.1 per cent
 (2) Total at 1 kilohertz 0.25 per cent
 (iii) Fixed function generators: Log X and sine/cosine:
 Static: 0.1 per cent.

Technical Note: The percentage for sub-item (a) (i) (1) (a) applies to the actual output voltage; all other percentages apply to full scale, that is from maximum negative to maximum positive reference voltages.
 Total errors at 1 kilohertz are to be measured with those resistors incorporated in the inverter, summer or integrator which provide the least error.

Total error measurements include all errors of the unit resulting from, for example, tolerances of resistors and capacitors, tolerances of input

and output impedances of amplifiers, the effect of loading, the effects of phase shift, and the generating of functions.

- (2) More than 75 operational amplifiers;
- (3) More than four integrator time scales, switchable during one programme;

(b) Analogue computers designed or modified for use in airborne vehicles, missiles or space vehicles and rated for continuous operation at temperatures from below -45° centigrade to above +55° centigrade; and equipment or systems incorporating such computers;

(c) Other analogue computers capable of accepting, processing and putting out data in the form of one or more continuous variables and capable of incorporating a total of at least 20 summers, integrators, multipliers or function generators with facilities for readily varying the inter-connections of these components;

(d) Digital computers with one or more of the following characteristics:

- (1) The CPU implements floating point operations by hardware;
- (2) The sum of either the 'I/O bus rate' or the 'total effective bit transfer rate', whichever is less, and the 'CPU bus rate' exceeds 10.8 million bits per second;
- (3) The internal memory has a total connected capacity (excluding parity, word marker and flag bits) of more than 0.8 million bits;
- (4) The computer is equipped with peripheral memory devices as follows:

- (i) More than 12;
- (ii) The 'total effective bit transfer rate' (excluding data channels not equipped with peripheral memory units) exceeds 0.7 million bits per second;
- (iii) Any magnetic tape transport with:
 (a) More than 800 bits per inch per track;
 (b) More than 75 inches per second tape speed;
 (c) More than 9 tracks per 1/4 inch tape width; or
 (d) More than 1/4 inch tape width.
- (iv) For peripheral memory devices other than magnetic tape transports:
 (a) Total connected 'net capacity' exceeds 3 million bits;
 (b) 'Total number of accesses' exceeds 120 per second.

(5) Computers with cathode ray tube displays as follows:

- (i) Used to display alpha-numeric and similar data or information, excluding those displays for which circuitry and character-generation devices external to the tube limit displays to alpha-numeric characters in fixed formats or to graphs composed only of the same basic elements as used for alpha-numeric character composition (this exclusion is limited to graphic displays for which the sequence of symbols and basic elements of symbols are fixed by the format and character generators in the unit and cannot be generated arbitrarily by the computer).
- (ii) With light gun or other graphic input devices, excluding those which are parts of displays for which circuitry and character-generation devices external to the tube limit displays to alpha-numeric characters in fixed format or to graphs composed only of the same basic elements as used for alpha-numeric character composition.

(e) Digital computers and digital differential analyzers (incremental computers) designed or modified for use in airborne vehicles, missiles or space vehicles and rated for continuous operation at temperatures from below -45° centigrade to above +55° centigrade; and equipment or systems incorporating such computers or analyzers;

(f) Other digital computers operated by one or more common control units and capable of all of the following:

- (1) Accepting, storing, processing and producing an output in numerical or alphabetical form;
- (2) Storing more than 512 numerical and/or alphabetical characters or having an internal memory of more than 2,048 bits;
- (3) Performing a stored sequence of operations that are modifiable by means other than a physical change in circuitry; and
- (4) Selecting a sequence from a plurality of stored operations based upon data or an internally computed result;

(g) Computers capable of operating in both analogue and digital modes and related equipment as follows:

- (1) Equipment whose analogue portion meets the conditions of sub-item (c) and whose digital portion meets the conditions of sub-item (f) and which also provides facilities for processing in the digital section numeric data from the analogue section and/or vice versa;
- (2) Equipment for inter-connecting the analogue and digital portions of computers as described in sub-item (g) (1);
- (3) Digital or analogue computers containing inter-connecting equipment as described in sub-item (g) (2);

(b) Specialized parts, components, peripherals, sub-assemblies, accessories, and spare parts for the above, including those which are also described in Items I.L. 1572 and I.L. 1588.

Analogue computers covered by sub-items (a) (1) (i) (a), (a) (i) (ii) (a), (a) (2) and (c), digital computers covered by sub-items (d) (1)-(4) and (f) and equipment for such computers covered by sub-item (h), subject to certain conditions, including:

- (a) that the equipment is primarily used in non-strategic applications;
- (b) that the equipment will be used primarily for the specific non-strategic applications for which the order would be approved and that the number, type and characteristics of such equipment are normal for the approved use;

(c) that if they are analogue computers covered by sub-items (a) (1) (i) (a), (a) (1) (ii) (a) or (a) (2), the static rated error for summers, inverters and integrators are not less than 0.01 per cent and for multipliers are not less than 0.025 per cent and there are not more than 550 operational amplifiers;

(d) that if they are digital computers covered by sub-item (d) (1)-(4), all of the following additional conditions are met:

- (1) The sum of either the 'I/O bus rate' or the 'total effective bit transfer rate', whichever is less, and the 'CPU bus rate' does not exceed 40 million bits per second;
- (2) The 'processing data rate' for CPUs which implement floating point operations by hardware does not exceed 8 million bits per second;
- (3) The internal memory total connected capacity (excluding parity, word marker and flag bits) does not exceed 2.36 million bits;
- (4) For peripheral memory devices with which the computer is equipped:
 (i) No more than 12 magnetic tape transports;
 (ii) The 'total effective bit transfer rate' excluding data channels not equipped with peripheral memory units does not exceed 8 million bits per second;
 (iii) The 'effective bit transfer rate' of any peripheral memory or data channel does not exceed 1.5 million bits per second;
 (iv) For peripheral memory devices other than magnetic tape transports:
 (a) Total connected 'net capacity' does not exceed 305 million bits;
 (b) For each independent device, 'net capacity' (in millions of bits) does not exceed 'average access time (in seconds) raised to the 3/2 power and then multiplied by 8,000; and
 (c) 'Total number of accesses' does not exceed 150 per second.

Interpretative definitions of the terminology used such as 'CPU bus rate', 'average seek time', etc. will be provided, if required, on application to the Export Licensing Branch.

1566. Equipment, as follows:

(a) All classes of devices, regardless of other characteristics, identified in sub-items (b), (c), (d), (e), (f), (g) and (h) below, which are designed to operate below -55° centigrade or above +125° centigrade;

(b) Synchros and resolvers (and special instruments rated to have the same characteristics as synchros and resolvers in (i) and (ii) below, such as Microsyns, Synchro-Tels and Inductosyns), possessing any of the following characteristics:

- (i) A rated electric error of 10 minutes or less or of 0.25 per cent or less of maximum output voltage;
- (ii) A rated dynamic accuracy for receiver types of 1 degree or less, except that for units of size 30 (3 inches in diameter) or larger a rated dynamic accuracy of less than 1 degree;
- (iii) Multi-speed from single shaft types;
- (iv) Employing solid state Hall effect;
- (v) Designed for gimbal mounting;

(c) Amplifiers, electronic or magnetic, specially designed for use with resolvers, as follows:

- (i) Isolation types having a variation of gain constant (linearity of gain) of 0.2 per cent or better;
- (ii) Summing types having a variation of gain constant (linearity of gain) or an accuracy of summation of 0.2 per cent or better;

(iii) Employing solid state Hall effect;

(d) Induction potentiometers (including function generators and linear synchros), linear and non-linear, possessing any of the following characteristics:

- (i) A rated conformity of 0.5 per cent or less, or of 18 minutes or less;
- (ii) Employing solid state Hall effect;
- (iii) Designed for gimbal mounting;

(e) Induction rate (tachometer) generators, synchronous and asynchronous as follows:

- (i) Employing solid state Hall effect;
- (ii) With a housing diameter of 2 in (50 mm) and smaller and a length (without shaft-ends) of 4 in (100 mm) and smaller or with a diameter-to-length ratio greater than 2:1, having one or more of the following characteristics:
 (1) With a rated linearity of 0.5 per cent or less;
 (2) All temperature-compensated or temperature-corrected types;

(f) Servo motors (gear-head or plain) as follows:

(i) Designed to operate from power sources of more than 300 cycles per second (except those designed to operate from power sources of over 300 cycles per second up to and not exceeding 400 cycles per second with a temperature range of from -25° centigrade to +100° centigrade);

(ii) Designed to have a torque-to-inertia ratio of 10,000 radians per second or greater;

(iii) Incorporating special features to secure internal damping;

(iv) Employing solid state Hall effect;

(g) Potentiometers (and special instruments rated to have the same characteristics as potentiometers in (i) and (ii) below, such as Vernistats), as follows:

- (i) Linear potentiometers having a constant resolution and a rated linearity of 0.1 per cent or less;
- (ii) Non-linear potentiometers having a variable resolution and a rated conformity of:
 (1) 1 per cent or less when the resolution is inferior to that obtained with a linear potentiometer of the same type and of the same track length;
 (2) 0.5 per cent or less when the resolution is better than or equal to that obtained with a linear potentiometer of the same type and of the same track length;

(iii) Designed for gimbal mounting;
 Explanatory Note: This sub-item does not include potentiometers using only switched elements.

(h) Direct current and alternating current torquers, i.e. torque motors specially designed for gyros and stabilized platforms;

(i) Electro-optical devices designed to monitor relative rotation of remote surfaces;

(j) Synchronous motors, as follows:

- (i) Of size 30 (3 inches in diameter) and smaller and having synchronous speeds in excess of 3,600 revolutions per minute;
- (ii) Designed to operate from power sources of more than 40 cycles per second;
- (iii) Designed to operate below -25° centigrade or above +100° centigrade;

(k) Ball-and-disc or cylinder-and-ball mechanical integrators; mechanical ball resolvers;

(l) Analogue-to-digital and digital-to-analogue converters, as follows:

- (i) Electrical-input types possessing:
 (1) A peak conversion rate capability in excess of 50,000 complete conversions per second;
- (2) An accuracy in excess of 1 part in more than 10,000 of full scale; or
 (3) A figure of merit of 10⁷ or more (derived from the number of complete conversions per second divided by accuracy);
- (ii) Mechanical input types (including but not limited to shaft position encoders and linear displacement encoders but excluding complex servo-follower systems) as follows:

- (1) Rotary types having an accuracy or maximum incremental accuracy better than ± 1 part in 10,000 of full scale;
- (2) Linear displacement types having an accuracy of better than ± 5 microns;

(iii) Employing solid state Hall effect;

(m) Semi-conductor Hall field probes, as follows:

- (i) Made of indium-arsenide-phosphide (In As P);
- (ii) Coated with ceramic or ferritic materials (e.g. special field probes such as tangential field probes, multipliers, modulators, recorder probes, etc.);
- (iii) With an open circuit sensitivity greater than 0.12 Volt
 Ampere x Kilogauss

Technical Note: The slope of a straight line that passes through the point of origin and through the point u_{oc} , i, at $B=B_n$, in the characteristic is defined as the open circuit sensitivity (where u_{oc} =Hall voltage, open circuit; i_c =Control current; B_n =Rated value of applied magnetic control field).

(n) Specially designed parts, components, sub-assemblies and test equipment (including adapters, couplers, etc.) for the above.

1570. Thermoelectric materials and devices as follows:

(a) Thermoelectric materials with a maximum product of the figure of merit (Z) and the temperature (T in °Kelvin) in excess of 0.75;

(b) Junctions and combinations of junctions using any of the materials in (a) above;

(c) Heat absorbing and/or electrical power generating devices containing any of the junctions in (b) above;

(d) Other power generating devices which generate in excess of 30 watts per pound or of 500 watts per cubic foot of the device basic thermoelectric components;

(e) Specialized parts, components and sub-assemblies, for the above devices (See also sub-item I.L. 1205(c)).

Technical Note: The figure of merit (Z) equals Seebeck coefficient squared divided by the product of electrical resistivity and thermal conductivity.

The weight and cubic measurements in sub-item (d) above are intended to encompass the complete device but to include only

Computers

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equipment, wherever located, during normal working hours and at any other time the equipment is

A "data device" which is: (a) Peripheral to a central processing unit - "main storage"

NB:

IL 1565

FOR THE PEOPLE'S REPUBLIC OF CHINA ONLY: 17. "Digital computers" or "related equipment" therefor embargoed by sub-item (b) provided that:

IL 1565 EXPLANATORY NOTE C 2 continued

XPDR = .85(32) + .15(32) + .55(16) = .85(3.77) + .15(28.93) = 5.41 million bits per second (iv) Floating point PDR (FP PDR) FP PDR = .85(32) + .15(32) + .4(16) + .15(32) = .85(3.77) + .09(25.37) + .06(28.51) = 6.01 million bits per second. (v) "Total PDR" "Total PDR" (8088/8087 at 4.77 MHz) = 6.01 million bits per second.

IL 1566

"Software" and technology therefor, as follows:

NOTE: The embargo status of "specially designed software" for the use of equipment described in other items in these Lists (except Item IL 1565) is dealt with in the appropriate item, and the embargo status of "software" for equipment described in Item IL 1565 is dealt with in the present item.

TECHNICAL NOTES:

1. "Software" is defined as follows: "software" - A collection of one or more "programmes" or "micro-programmes" fixed in any tangible medium of expression. "programme" - A sequence of instructions to carry out a process in, or convertible into, a form executable by an electronic computer. "microprogramme" - A sequence of elementary instructions, maintained in a special storage, the execution of which is initiated by the introduction of its reference instruction into an instruction register. 2. "Software" is categorized as follows (there is a close relationship and possible overlap among these categories): "development system" - "Software" to develop or produce "software". This includes "software" to manage those activities. Examples of a "development system" are programming support environments, software development environments, and programmer-productivity aids. "programming system" - "Software" to convert a convenient expression of one or more processes (source code) or (source language) into equipment executable form (object code) or (object language). "diagnostic system" - "Software" to isolate or detect "software" or equipment malfunctions. "maintenance system" - "Software" to: (a) Modify "software" or its associated documentation in order to correct faults, or for other updating purposes; or (b) Maintain equipment. "operating system" - "Software" to control: (a) The operation of a "digital computer" or of "related equipment"; or (b) The loading or execution of "programmes". "Software" not falling within any of the other defined categories of "software". 3. "Specially designed software" is defined as: The minimum "operating systems", "diagnostic systems", "maintenance systems" and "application software" necessary to be executed on a particular equipment to perform the function for which it was designed. To make other, incompatible equipment perform the same function requires: (a) Modification of this "software"; or (b) Addition of "programmes". (This ends the Technical Notes. For a complete list of definitions of terms used in the item, see Note 12 below; see also Item IL 1565 for additional definitions relating to electronic computers.)

EXPLANATORY NOTES

A. Conversion of Byte to bit in computing storage limits: (a) 1 MByte = (1024F Byte = 1.048,576 Byte

LISTED AS FOLLOWS:

(a) "Software" of whatever category, as follows: (1) "Software" designed or modified for any computer that is part of a computer series designed and produced within a proscribed area; except "application software" designed for and limited to: (i) Accounting, general ledger, inventory control, payroll, accounts receivable, personnel records, wages calculation or invoice control; (ii) Data and text manipulation such as sort/merge, text editing, data entry or word processing; (iii) Data retrieval from established data files for purposes of report generation or inquiry for the functions described in (i) or (ii) above; or (iv) The non "real time processing" of pollution sensor data at fixed sites or in civil vehicles for civil environmental monitoring purposes; (2) "Software" designed or modified for the design, development or production of items embargoed in these Lists; (3) "Software" designed or modified for: (i) Embargoed "hybrid computers"; (ii) One or more of the functions described in Item IL 1565 (b) (i) (i) (a) to (j) or (m) or (h) (2) (vi) or for "digital computers" or "related equipment" designed or modified for such functions, except the minimum "specially designed software" in machine-executable form for "digital computers" and "related equipment" therefor which are freed from embargo only by Item IL 1565 (h) (2) (i) or (ii), and only when supplied with the equipment or systems; (4) "Software" for computer-aided design, manufacture, inspection or test of items embargoed in these Lists; (5) "Software" designed or modified to provide certifiable multi-level security or certifiable user-isolation applicable to government-classified material or to applications requiring an equivalent level of security, or "software" to certify such "software"; (b) Categorized "software" as follows: (1) "Development systems" as follows: (i) "Development systems" employing "high-level language" and designed for or containing "programmes" or "databases" special to the development or production of: (a) "Specially designed software" embargoed by any other item in these Lists; (b) "Software" embargoed by sub-items (a) (2) or (a) (3) of this item; including any subset designed or modified for use as part of such a "development system"; (ii) "Development systems" employing "high-level language" and designed for or containing the "software" tools and "databases" for the development or production of "software" or any subset designed or modified for use as part of a "development system" such as, or equivalent to: (a) Ada Programming Support Environment (APSE); (b) Any subset of APSE, as follows: (1) Kernel APSE; (2) Minimal APSE; (3) Ada compilers specially designed as an integrated subset of APSE; or (4) Any other subset of APSE; (c) Any superset of APSE; or (d) Any derivative of APSE; (2) "Programming systems" as follows: (i) "Cross-hosted" compilers and "cross-hosted" assemblers; NOTE: For "cross-hosted" compilers and "cross-hosted" assemblers which have to be used in conjunction

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central processing unit exceeding 28 million bit

(4) Input/output

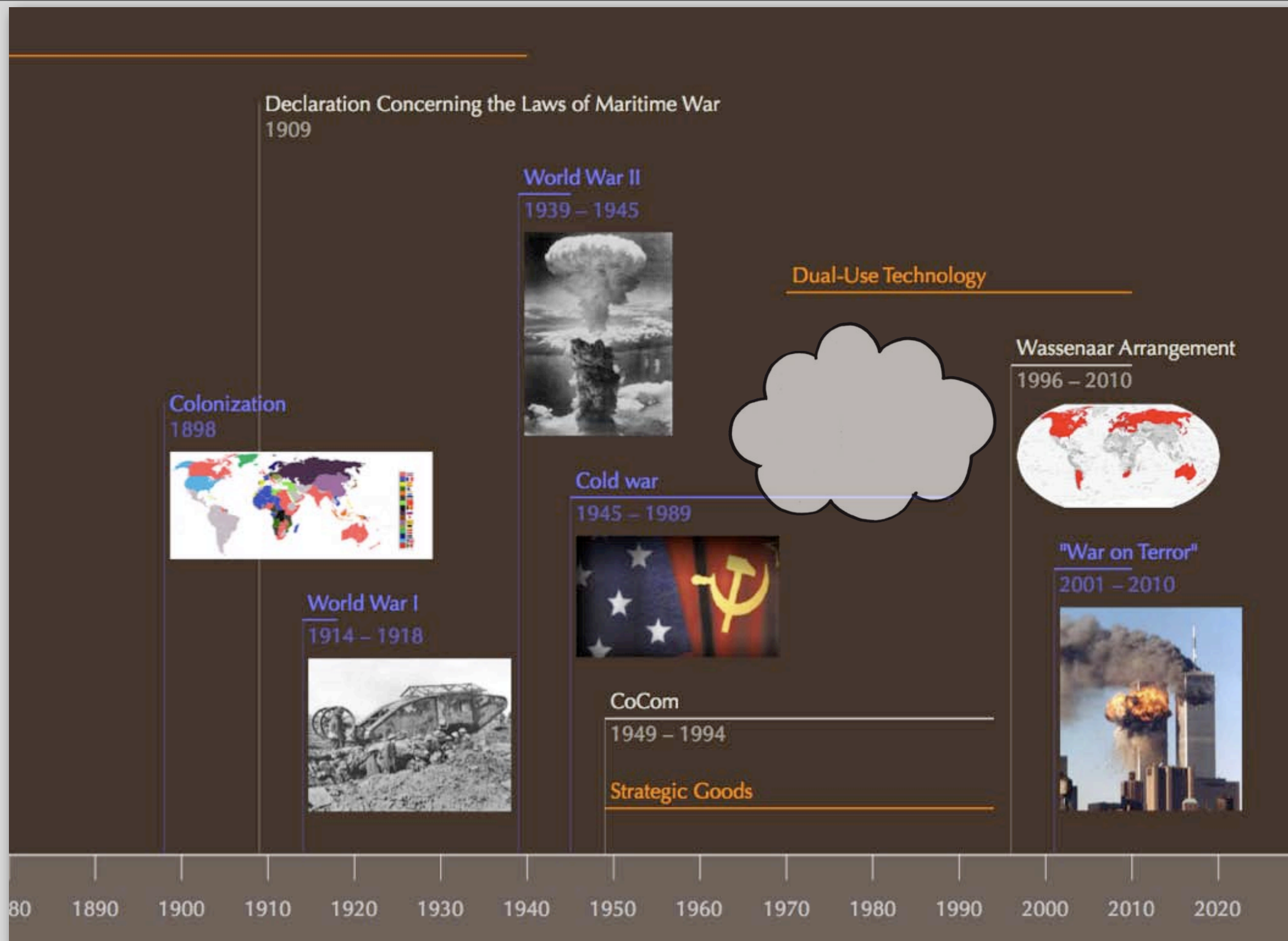
74 Security export control March 1989



Computers



How did ambiguity in responsibility come back in?



Dual-Use Technology

The Wassenaar Arrangement



The Wassenaar Arrangement

Who has responsibility for controlling the distribution of the means of destruction?

List of Goods Subject to

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Comparison of CoCom and Wassenaar Lists

CRITERIA FOR THE SELECTION OF DUAL-USE ITEMS

(as updated at the December 2005 Plenary)

Dual-use goods and technologies to be controlled are those which are major or key elements for the indigenous development, production, use¹ or enhancement of military capabilities². For selection purposes the dual-use items should also be evaluated against the following criteria:

- Foreign availability outside Participating States.
- The ability to control effectively the export of the goods.
- The ability to make a clear and objective specification of the item.
- Controlled by another regime³.

Dual-Use Technology

What is the defining principle used to resolve ambiguity in the items to be controlled?

How did technological ambiguity come back in?

Terrorist Technologies

Problem of monitoring flows rather than controlling them



How did ambiguity
in responsibility
come back in?

Breakdown of basic/ applied research distinction

Pushing control back to the
bench

Statement on Scientific Publication and Security

Preamble

The process of scientific publication, through which new findings are reviewed for quality and then presented to the rest of the scientific community and the public, is a vital element in our national life. New discoveries reported in research papers have helped improve the human condition in myriad ways: protecting public health, multiplying agricultural yields, fostering technological development and economic growth, and enhancing global stability and security.

But new science, as we know, may sometimes have costs as well as benefits. The prospect that weapons of mass destruction might find their way into the hands of terrorists did not suddenly appear on September 11, 2001. A policy focus on nuclear proliferation, no stranger to the physics community, has been with us for many years. But the events of September 11 brought a new understanding of the urgency of dealing with terrorism. And the subsequent harmful use of infectious agents brought a new set of issues to the life sciences. As a result, questions have been asked by the scientists themselves and by some political leaders about the possibility that new information published in research journals might give aid to those with malevolent ends.

Journals that dealt especially with microbiology, infectious agents, public health, and plant and agricultural systems faced these issues earlier than some others, and have attempted to deal with them. The American Society of Microbiology, in particular, urged the National Academy of Sciences to take an active role in organizing a meeting of publishers, scientists, security experts, and government officials to explore the issues and discuss what steps might be taken to resolve them. In a one-day workshop at the Academy in Washington on January 9, 2003, an open forum was held for that purpose. A day later, a group of journal editors, augmented by scientist-authors, government officials, and others, held a separate meeting designed to explore possible approaches.

What follows reflects some outcomes of that preliminary discussion. Fundamental is a view, shared by nearly all, that there is information that, although we cannot now capture it with lists or definitions, presents enough risk of use by terrorists that it should not be published. How and by what processes it might be identified will continue to challenge us, because—as all present acknowledged—it is also true that open publication brings benefits not only to public health but also to efforts to combat terrorism.

The Statements Follow:

FIRST: The scientific information published in peer-reviewed research journals carries special status, and confers unique responsibilities on editors and authors. We must protect the integrity of the scientific process by publishing manuscripts of high quality, in sufficient detail to permit reproducibility. Without independent verification—a requirement for scientific progress—we can neither advance biomedical research nor provide the knowledge base for building a strong biodefense system.

SECOND: We recognize that the prospect of bioterrorism has raised legitimate concerns about the potential abuse of published information, but also recognize that research in the very same fields will be critical to society in meeting the challenges of defense. We are committed to dealing responsibly and effectively with safety and security issues that may be raised by papers submitted for publication, and to increasing our capacity to identify such issues as they arise.

THIRD: Scientists and their journals should consider the appropriate level and design of processes to accomplish effective review of papers that raise such security issues. Journals in disciplines that have attracted numbers of such papers have already devised procedures that might be employed as models in considering process design. Some of us represent some of those journals; others among us are committed to the timely implementation of such processes, about which we will notify our readers and authors.

FOURTH: We recognize that on occasion an editor may conclude that the potential harm of publication outweighs the potential societal benefits. Under such circumstances, the paper should be modified, or not be published. Scientific information is also communicated by other means: seminars, meetings, electronic posting, etc. Journals and scientific societies can play an important role in encouraging investigators to communicate results of research in ways that maximize public benefits and minimize risks of misuse.

Journal Editors and Authors Group*

Editor's note: This statement also appeared in the 18 February 2003 issue of the *Proceedings of the National Academy of Sciences* and the 20 February 2003 issue of *Nature*.

*A list of the individual authors is available on Science Online at www.sciencemag.org/cgi/content/full/299/5610/1149/DC1.

Industrial/commercial developments

- “configuring the user” to be peaceful/legitimate/benevolent...
- But however much ethics are embedded in technologies, there is still interpretative flexibility
- example: night vision

Review of 3 attempts at controlling means of destruction/destabilization

	Sovereign	Classification distinction	Causes of social ambiguity	causes of technological ambiguity
Contraband	King	war/peace	colonization, world wars	determining “use”, always at war
Strategic Goods	International Groups	us/them	fall of USSR	shift to cooperation with USSR
Dual-Use	State, international harmonization	“states/entities of concern”	locus of production & rise of terrorism	rise of terrorism, pushing control back to the bench

The next system?

- Resolving ambiguity in responsibility for control?
 - Distributed; no longer security of the nation
 - Coupling with other security issues (e.g. intellectual property)
- Resolution of technological ambiguity?
 - A shift to use and intent --> need for intelligence
 - Lists based on context (not one list for all), and rapidly change

A world map in a pseudo-cylindrical projection with a light gray grid. Countries are shaded in a light red color. The highlighted countries include Canada, the United States, Russia, China, Brazil, Australia, and New Zealand. Other countries like Mexico, India, and the UK are not highlighted.

Questions?

Samuel A. Evans
samuel_evans@hks.harvard.edu