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**SWEDISH DEFENCE
RESEARCH ABSTRACTS 1979/80-3**

by

National Defence Research Institute, Stockholm

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Procurement Executive, Ministry of Defence
Farnborough, Hants

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SWEDISH DEFENCE RESEARCH ABSTRACTS 1979/80-3
(FRÖ FÖRSVARS FORSKNINGS REFERAT 1979/80-3)

by

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EDITOR'S SUMMARY

The Swedish National Defence Research Institute issues a quarterly list of unclassified Reports published by the Institute. The titles of these Reports and informative abstracts have been translated in English. This volume is the third issue of 79/80. Further volumes will be translated in due course. The main topics covered are: Protection - atomic, biological, chemical; ammunition and weapons; conduct of war, information and commands; vehicles and spacecraft; reliability and logistics; human factors; associated studies and their solutions; positive methods for limitation and control of armaments; psychology reports.

EDITOR'S NOTE

The Reports are in Swedish unless some other language is indicated (usually English). When requesting Reports it should be appreciated that an English version will not normally be available, and that the prices of the original Swedish documents have not been indicated in this Translation. Reports may be obtained from:

FOA Centralkansliet, 104 50 Stockholm, Sweden

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A PROTECTION - ATOMICA2 Nuclear warheads, basic characteristics and products

- (122) FCA report C20342-A2
 Relaxation of charged particles injected into a hot plasma (in English)
 Nils Hörnqvist March 1980

The article derives the relaxation of charged particles in a plasma, with a precise treatment of close collisions. A comparison with the classical 'lnA'-theory shows a significant discrepancy for ion-ion relaxation.

C PROTECTION - CHEMICALC1 Threat scenario

- (123) FCA report B40100-C1
 Muscarinic acetylcholine receptor (in English)
 Edita Heilbronn and Thomas Bartfai

The article is a review of what is known at present about muscarinic acetylcholine receptor.

FCA Reprints 79/80:13

C3 Injuries and treatment - chemical

- (124) FCA report B40102-C3
 α -toxin binding proteins in the electric organ of *Torpedo marmorata* studied by immunochemical methods (in English)
 C. Mattson and others

A cross-immuno-electrophoretic technique has been devised to trace the purging of the acetylcholine receptor from the electric organ of *Torpedo marmorata*, together with a new binding technique for toxins. Raw extract of membrane from the electric organ contains a receptor molecule of molecular weight about 500000. The form described previously with a higher molecular weight is an artefact of chromatography.

Independent antibodies against electroplex membrane, and antibodies against purified membrane proteins and against *Baja Baja* venomous α -neuro-toxin reveal four α -toxin-binding antigens (including α ACHR). Two of them, α ACHR and α_2 , are specific to electroplex membrane, and show partial immun-identity though different biochemical and physical properties.

FCA Reprints 79/80:15

- (125) FCA report B40103-C3
 Acetylcholine receptor antibodies in the diagnosis of human and experimental myasthenia gravis (in English)
 Edita Heilbronn and others

An account is given of the immunology of acetylcholine receptor and circulating antibodies. Special reference is made to some aspects of human and experimental myasthenia gravis. Receptor antibodies, which exhibit negligible cross-reactivity with skeletal muscle receptor, can nevertheless cause a breakdown of the post-synaptic motor endplate regions. Antibodies of human skeletal muscle receptor are bound to in situ receptors. The transfer of myasthenic IgG increases the neurophysiological symptoms in canines which have slight symptoms of experimental myasthenia, indicating a blocking of in situ receptors. Measurement of receptor antibodies by means of the RIA test and in some cases purified human skeletal muscle receptor has been evaluated as a diagnostic aid

for myasthenia gravis. Ninety percent of Swedish myasthenics were found to have receptor antibodies. A rough correlation was discovered between the strength of antibody solutions and the severity of the disease. The strength of the solution is decreased by immunosuppressive treatment and thymectomy. Strong antibody solutions are left in patients retaining the thymus. A summing-up shows that a determination of antibody titres and electrophysiological tests - especially single-fibre electromyography - are very useful diagnostic tools.

FOA Reprints 19/80:14

D AMMUNITION AND WEAPONS TECHNOLOGY

D2 Gunnery technology and associated ballistics

- (126) FOA report C20338-D2
The signature of ammonium perchlorate propellant for an anti-tank projectile fired from a rocket launcher
Lars Ax February 1980

For a new anti-tank projectile based on a fast-burning composite propellant in a rocket launcher, the size of the signature is assumed to be decisive for the extent of the tactical use of this weapon.

The smoke cloud formed by the propellant has a certain toxic effect at the same time as it may give away the marksman and reduce the possibility of rapidly repeated fire. Combustion of composite propellant was therefore carried out at FOA in the Spring of 1979 in order to investigate the size and duration of the smoke cloud as a function of weather conditions such as humidity, temperature and wind.

The results, which demonstrate that heavy smoke is formed at most temperatures and humidities, are held by FOA 273 on video tape and 16mm film.

An experiment is being performed in order to estimate the conditions for the formation of smoke at different parts of the country in the course of a year.

- (127) FOA report C20343-D2
Stability measurements on projectiles having different surface smoothness.
MALFOM 4:4831, Stage 4
Sven Nordström March 1980

The effect of changes to the surface smoothness of a projectile on its aeroballistic properties was investigated in Stage 4 of the MALFOM 4:4831 program. With three different degrees of surface smoothness, 10, 50 and 100 µm, 15mm projectiles of the standard shape were fired at four velocities on the Northern range in order to determine aerodynamic moments and stability factors. These were found to be only very weakly dependent on surface smoothness, so that any modification of this cannot be utilised, eg for purposes of improving stability.

Dynamic stability at Mach 0.9 approximately was found in these tests to be strongly dependent on the maximum amplitude of oscillation, with a critical value of about 5° , at which angle almost all the projectiles were dynamically unstable.

No measurements of scatter were made at this stage for long-range firing. The range as a function of surface smoothness can be quite well calculated, and no measurable change in dispersion with variations in surface smoothness has been thought likely, in connection with stability tests, provided that surface smoothness was held almost constant

over the series. On the other hand variable surface smoothness in a batch of ammunition can give rise to some increased dispersion of range.

(117) FCA report CPO344-22
Wind-measurement trials using parachutes
Sven Nordström

March 1950

Wind measurement by radar tracking of a parachute instead of a balloon has been previously tried with promising results. It was therefore thought useful to continue investigations by releasing parachutes at higher altitudes.

The ammunition used consisted of the 8cm Lotta flare, the M/70 15cm flare and the M/70 30cm flare, released at altitudes between 1000 and 6400 m. The parachutes were tracked by radar from both AF and RPK. For comparison in subsequent tests the wind was also measured by tracking hydrogen balloons both by the CCKA system and on radar.

As a rule the radars acquired their targets without visual aids. The wind as measured by means of the parachutes generally agreed well with measurements by balloon, apart from some errors in the latter owing to wrongly recorded surface values. Even when the radar locked on to some part of the flare body falling at a considerably faster rate than the parachute, good measurements were sometimes obtained. Bodies falling at faster rates than the parachute, though having a lesser tendency to drift or none at all and a sufficiently large radar target area, ought to yield reliable results. According to an Australian report spheres of suitable size and weight could be used for the purpose.

The occurrence at low altitudes of clearly dissimilar winds (of the jetstream type), well corrected in altitude, was demonstrated. The need for correct and closely spaced wind measurements, or in range-table firing was shown by calculations of trajectories, and wind measurements over the course of a day.

(118) Technical report - Nordström

Wind-measurement trials using parachutes

Investigation of the propagation of the front of solidification in the casting of explosives

March 1950

The object of the study reported here was to investigate how the front of solidification propagates during the controlled casting of explosives in a cylindrical mold, in order to determine a suitable temperature curve for the interface between the melt and the mold.

The experimental set-up and the method used for the 'dye front' method in two spatial dimensions, and the analytical solution of the heat conduction problem.

The results in the form of theoretical curves of how different temperature patterns affect solidification, and the experimental results.

The report is based on the work of the CCKA experimental unit in the program during winter 1949. The program was carried out in the laboratory of the AF and in the AF laboratory, and the CCKA laboratory at the AF. The program is of interest, preferably for the AF and the AF.

- (130) FOA report C20345-D4
Flash X-ray photography of the jet from a shaped charge. Description of the design of the experiment and evaluation program
Åke Collin March 1980

The straightness of the jet from a shaped charge is of relative importance for the penetration power of the charge. For a more detailed study of the straightness of the jet from a shaped charge and its other properties, an experimental apparatus for the stereo recording of the impulse at two instants of time was devised in FOA 5, together with an associated evaluation program for the flash X-ray pictures obtained with it.

This Report deals with the apparatus, the program and its application.

- (131) FOA report C20347-D4
Jet-forming and projectile-forming shaped charges. An experimental comparison
Jan Ekberg and Lars Holmberg March 1980

An experimental investigation was performed into the properties of shaped charges (RSV) with conical copper inserts of equal thickness, where the whole conical angle varied from 60° (purely jet-forming charge, RSV III) and up to 120° (purely projectile-forming charge, RSV IV). The transitional forms between the 'pure' RSV III and 'pure' RSV IV were particularly studied.

The form of the projectile (jet) was recorded by means of Flash X-ray photography, and the velocity distributions were calculated. An account is given of the penetration power and hole profiles.

- (132) FOA report C20348-D4
A shaped charge against aluminium
Jan Ekberg March 1980

Object: To obtain some idea of the protective ability and the appearance of the stand-off curve of a shaped charge for two standard grades of aluminium (Al 4212 and Al 4338).

Method: Twenty-six 45mm shaped charges containing 1% of compressed octogen were detonated against 10mm thick plates clamped to form a stack. Detonation distance: 2, 10, 15 and 20 x the calibre of the explosive, with at least three detonations at each distance.

The plates were tested for their Vickers hardness, and penetrations and hole diameters were measured.

Results. The report gives:

- (a) the stand-off curve in a target material of commercial iron SIS 1311,
- (b) the stand-off curve in a target material of aluminium SIS 4212-6,
- (c) the stand-off curve in a target material of aluminium SIS 4338-6,
- (d) hole diameters in the abovementioned target materials,
- (e) the protective factor with respect to commercial iron SIS 1311.

D8 System studies

- (133) FOA report C20332-D8
A model for regression analysis and some transformations of the incoming variables
Göran Stern January 1980

The report describes a method for treating multiply linear problems in regression analysis. The technique employed is based on the fact that a multiply linear model for regression analysis can be considered as consisting of a number of singly linear models for regression analysis.

The (final) model is chosen on what is termed the 'stepwise' principle.

The model is programmed on to an IBM 370 in PL/1, and its printouts include a number of estimated quantities and a plot of residuals as an aid to statistical analysis, model control etc.

A number of transformation classes are associated with the model. By means of these classes it is possible to study in greater depth multiply linear relations, assumptions as to distribution and certain types of non-linear models of regression analysis.

The model and the program package have been produced chiefly for analysing problems in the calculation of effectiveness.

Experience gained in the problems affecting armour and aerial targets, on which the program package has been used hitherto, have been partly responsible for the version presented here, which is mainly concerned with manipulation via *GUTS*.

It is planned to supplement the model and the program subsequently by other and, it is hoped, more general transformation classes, special versions for certain specific problems of effectiveness and the treatment of some problems of analysis in the area of field studies.

(134) FOA report C20335-D8
 'SGR 2000' - A draft concept for a 155mm explosive shell with long range and large lethal zone
 Kurt Andersson and Rune Hellgren February 1980

A major part of military research is now being devoted to studies of warfare under conditions of the 21st century. This also applies to the area of indirect fire, or MUR/SI. This very limited study has been conducted partly in order to provide the study group with an example of up to date information on artillery ammunition.

What is known as the *PROBUS* program represents an optimisation of the range and stability of a 155mm shell with a base-flow unit, designated 'Sgr 2000', to give the longest possible range. To begin with no other constraints have been imposed than calibre, muzzle stability (at a rifling pitch angle of 9°) and certain realistic thicknesses of materials. The results presented here shows that ranges greater than 30 km can be obtained for muzzle velocities of about 800 m/s and with a lethal zone greater than for instance the Sgr m/77. A large amount of data is provided concerning this shell.

(135) FOA report C20337-D8 (E1, E3)
 Conference on Defence requirements for topographical information
 Nils Melander and Anders Wellving February 1980

Some 100 participants attended the FOA 2 conference on topographical information held on 19 October 1979. The newly-formed section on Physical Environments in FOA O2 Branch was responsible for arranging and conducting the conference. The purpose of the gathering was to try to give a composite picture of Defence requirements for topographical information and of the activities in progress in this subject.

The program included three lecture sessions and a final discussion. The sessions dealt with the following subjects:

- (i) Requirements of the military staffs for topographical information for research, combat planning and operational use.
- (ii) Studies and research involving topography in the FCA.
- (iii) Computer techniques for processing and utilising topographical information.

- (136) FOA report C20339-D8
FOA thinking on Army formations in AD 2000: a general account of methods and results
Jan Wennström and Karl-Erik Rising February 1980

This report deals with the methods being used in the FCA thinking about Army formations in AD 2000, which was mainly performed during 1977 and 1978. The process, from formulation of the problem to the complete ideas, is discussed and the experience is compared with current methods for generating ideas.

The draft concepts were reported in the form of diagrams in a special order distributed to FMV-A, Ast/Stud and branches of FOA concerned.

The report also covers the subsequent preliminary evaluations which were undertaken, in the light of the draft concepts, in order to propose which R&D projects should be put into operation.

It is intended to follow this report with an account of proposals for the R&D projects.

- (137) FOA report C20340-D8
Report of a visit to the USA and Canada to study techniques of target description
Gunnar Holm March 1980

During October-November 1979 a visit was paid to the USA and Canada as part of the project 'Aids to Target Description' contained in the 'Development project on the Calculation of Effectivity'. The study concerned the methods of performing target description at the US Army Ballistic Research Laboratory (BRL). Further visits were paid to universities in Ottawa and Utah for discussions on geometrical and graphical data processing, and to the data-processing conference of ACM (Association for Computing Machinery) in Detroit.

- (138) FOA report C20346-D8
Development project on the calculation of effectivity - Interim report
Margareta Franzén and others March 1980

A development program has been in progress since the Spring of 1978 concerning conventional weapons, with the object of improving possibilities for a wider, more decentralised and flexible utilisation of existing computer programs as a tool both for research and for outward-directed information work. This activity is intended to enable us in future to produce more reliable results with a smaller effort, less dependence on key personnel and within a shorter period.

The report covers the state of work in January 1980.

E CONDUCT OF WAR - INFORMATION AND COMMAND TECHNIQUE

- (139) FOA report C30183-E
Optical electronics - apparatus and techniques
Daniel Glansholm January 1980

This compendium of optical electronics (optronics) covers the field, starting with technical descriptions of the apparatus and military applications. The object was to describe optronic components and phenomena in their context, ie together with the technical and functional description of optronic equipment in which such components and phenomena play a fundamental role. The presentation is mainly of a general nature, intended to give a relatively broad picture of optronics and its current state of development. Close attention is also paid to range calculations for optronic apparatus in some typical cases.

The report constitutes the collected materials from lectures on optronics of the Army and Navy Senior Technical Course at the Military College between 1970-1979. It is my hope that this information will now reach a wider audience, so that all those who are more or less peripherally in contact with optronic apparatus will be able to use the present systematic and illustrative account of the subject.

(140) FGA report C30184-E
Computer program for calculations of laser safety
Per Strandberg and Ove Steinvall
January 1980

The report describes a computer program for calculating danger levels and/or distances in connection with the use of lasers.

The hygienic limiting values employed have been derived from American standards (ANSI 1980) currently in force in Sweden.

The programming language is a modified *BASIC* as used on the Hewlett Packard desktop HP 214.

E1 Reconnaissance, target location and fire control

(141) FGA report C30168-E1
The importance of transmission properties of the sea in the design of hydroacoustic systems.
E active hydrophone systems
Tore Bertelius
November 1979

The present series of reports describes, mainly in theoretical terms, some aspects of the transmission properties of the sea and their importance for the optimum design of acoustic systems for underwater use. This second part deals with active hydrophone systems. The fundamental properties of reverberation are first described, and it is shown how with a sliding time-window they can be characterised with a Rayleigh distribution for narrow-band signals. A newly developed method of measuring reverberation is demonstrated at Appendix A. Since it is a matter of very great importance for active hydrophone systems that the emitted signal should be of the optimum form with respect both to the target echo and to reverberation (and any other noise), Appendix B is devoted to a detailed description of signal shaping, based on a mathematical description of dolphin signals. The signal in that case cannot generally be regarded as narrow-band. It is shown how, with this design of signal, it is possible to determine the parameters of the target echo which are practically independent of the speed of the target. An optimum detector for a target echo of known constituent parameters is shown together with a simplified version of it. The optimum system for an unknown target in unknown ambient noise requires adaptation both of the signal and the detector. A section is devoted to showing how the determination of range and speed of the target can be designed.

Finally some description is supplied of a design (under development) of a measuring system partly intended for the investigation of reverberation and the parameters of target echoes. The design of the measuring system will be flexible enough to permit the testing of different methods of signal processing which simulate different active systems.

- (142) FOA report C30170-E1
 Analysis of an adaptive hydrophone system
 Lars Götherström and Viggo Westerlin December 1979

An adaptive hydrophone system based on a gradient projection algorithm is analysed in terms of its method of functioning. A geometrical approach is adopted. Some economies in the amount of computation can be achieved at the cost of sub-optimum solutions to the problems. An alternative algorithm is presented based on the steepest-descent method.

- (143) FOA report C31077-E1, E4
 Miniaturised 9-position switch for 6-15 GHz
 Herbert Steyskal January 1980

Three versions of a 9-position band switch have been made and tested. The last model was produced on a 50 x 50mm Duroid substrate, and was distinctive for its simple design. At given frequencies in the 6.5-14.5 GHz band an insertion loss of 4.7 dB and a VSWR of 1.8 were measured on the worst of the nine allotted channels.

The switch can be used as a genuine broadband component between 6 and 18 GHz in each channel if a maximum attenuation of 7 dB is permitted at certain frequencies.

The report supplies additional information on a number of detailed studies concerning multi-channel switches.

- (144) FOA report C30179-E1
 Annual Report 1979 (in English)
 Department of image processing. FOA 820, 331 and 530

The report supplies a review of activities in the field of image processing during the calendar year 1979.

E2 Communications

- (145) FOA report C30178-E2
 Interpretation and tabulation of ionographs
 T. Sandén December 1979

The report describes the rules of analysis, methods and tabulation for the interpretation of ionographs. It is mainly based on URSI manuals and recommendations, though arranged so as to make the method of interpretation for Swedish ionospheric stations as efficient and uniform as possible, without disregarding international standards of interpretation.

E3 Guidance, navigation and target identification

- (146) FOA report C20336-E3
 A small operational core system for real-time runs on the Nord-10
 Svante Jahnberg February 1980

A Nord-10 computer was used to calculate control signals in a feedback control system. In order to perform this task a simple operational core system has been developed which is economical of storage. This can be operated with a foreground and a background program, both of them written in Fortran.

(147) FOA report C30180-E3
 A study of the control principles in guided S/A missiles
 Thomas Gundmark

January 1980

The present study is based on a Russian manual, translated into German as 'Schiessen mit FLA-raketen' (Launching of Surface-Air Missiles), written by F.K. Neupokajen. A large part of this book is devoted to guided missiles. One interesting control principle which is described is guidance with a degree of anticipation. This can vary in theory from pure collimation guidance to ideal guidance to the collision point by varying a control constant between 0 and 1.

The purpose of the study is to examine how a variation of this control constant affects important properties such as the coverage area, acceleration requirements etc in certain types of missile with different speed profiles.

Briefly summarised, the study demonstrates that the effect of the control constant on the coverage area of a given type of missile is only moderate. The effect on a missile's ability to strike a manoeuvring target is similarly slight.

Not unexpectedly however, the acceleration requirement for a missile is found to decrease with an increasing value of the control constant.

It may be concluded therefore that the method of control is of more interest from the aspect of design than from a tactical aspect.

F VEHICULAR AND SPACECRAFT TECHNOLOGY

F9 Materials

(148) FOA report C20334-F9
 The redesign of an autoclave
 Börje Røjdås

February 1980

An autoclave which was procured for the manufacture of laminated fibres was found on delivery testing not to meet its specifications. The autoclave was therefore supplemented at the FOA by a new heating element, new insulation etc. The manufacturer took responsibility for the cost by a price reduction.

(149) FOA report C20349-F9
 Examination of the breakdown of composites by heat, and the form and electrical resistance of the small particles thereby produced
 Tom Karlsson

March 1980

Small pieces of carbon-fibre composites 3501/EHTS (Hercules 3501); 3501/HMS: Fiberdux 914C/T-300 and Fiberdux 914C/MS-5 were heated to different temperatures between 1200 and 350°C over different periods. All the samples disintegrated by first becoming delaminated, after which the separate layers broke into smaller bits of slivers of half-detached carbon fibres, and after destruction had proceeded for a long time free carbon fibres were formed. By that time their diameter had greatly decreased. The plastic produced both gaseous products and a tar-like substance which strongly contributed to the low occurrence of free carbon fibres. The electrical resistance of the carbon fibres was unchanged by heating. The heating of small particles of Fiberdux 914C/T-300 obtained by mechanical processing at room temperature produced similar results.

H HUMAN ENVIRONMENTH6 Individual and group efficiency

- (150) FOA report B57013-H6
Muscle glycogen depletion and lactate concentration during downhill skiing
Per Tesch and others (in English)

Trained downhill skiers and physically active test subjects, though having less experience of downhill skiing (proponents of the research) were studied during skiing in order to describe the metabolic requirements of this activity.

The concentration of glycogen and lactate were determined in biopsy tests taken from m. vastus lateralis. The glycogen concentration in the trained group was depleted by 32 mmoles/kg of wet muscle during one day's intensive training. Completely exhausted deposits of glycogen could be observed in a few individual cases. The corresponding value for the volunteer group was 22 mmoles/kg of wet muscle. The storage of glycogen during one night corresponded with the consumption during training by the volunteer group, though not in the trained group. Fast (FT, glycolytic) as well as slow (ST, oxidative) muscle fibres were depleted of glycogen during exertion. However in the trained group the ST fibres recovered to a greater extent than in the volunteer group.

After a 'skiing class' the concentration of lactate in muscle was 5 mmoles/kg of wet muscle. After 'maximum' skiing for 1 min an increase took place to 13 mmoles/kg of wet muscle. There was however a wide individual variation (5-26 mmoles/kg wet muscle), which was related to the relative proportion of FT fibres in the muscle under study. This is in agreement with laboratory experiments (Tesch et al: Acta physiol. Scand. (1976) 103, 40-46; Tesch: Acta physiol. Scand. (1978), 104, 373-374). On the other hand the concentration of lactate was not related to the level of training. The results point to a more pronounced aerobic energy metabolism among trained skiers than with untrained persons. Furthermore the results may underlie the assessment of risk factors in skiing when practised for recreation.

Offprint from Medicine and Science in Sport (1980), 10, 89-90

FOA Reprints 79/80:16

- (151) FOA report C54030-H6
Accommodation environment on board ship. A questionnaire study of different designs of 4-berth cabin in Minelayer 3
Göran Stensson and others February 1980

The purpose of the investigation, as part of the information for a decision as to the choice of cabin design on board Minelayer 3, was to obtain data about the attitudes towards the environment in crews with some experience of work on board ship. Groups of national servicemen, cadets, officers and technical personnel answered a questionnaire while occupying full-scale models of two test cabins which represented different designs. A brief interview was also held. The preferences of the test subjects were recorded, and further studies of environments on board ship are under discussion.

- (152) FOA report C56021-H6
The learning of a ballistic task
Henry Widén and Kenth Carlsson February 1980

The purpose of the experiment was to investigate what degree of learning can be expected of gun crews in a ballistic task where the performance of the weapon and the

target characteristics are unknown from the outset. Sixteen national service mortar crew personnel were divided into two equal groups. Their task was, using an airgun fitted with a telescopic sight, to hit a target moving at different ranges and speeds about a pool of water. No information was provided on the target parameters, of the ballistics of the weapon nor on how to use the sighting apparatus. During six learning practices each of 30 shots with feedback of the scores, one group was given random sets of distance-speed combinations, while the other group was given the same combination systematically ordered. A test practice of 72 shots was then fired with new combinations, in random order and similar for both groups. The result showed that the marksmen nearly doubled their scores during the learning practice (from 30-56% hits), and that they could probably increase their performance still more with a longer learning period. No difference was found to exist between the two methods of learning. Some possible reasons for the result are discussed, and conclusions are drawn for further experiments.

H9 Man and machine systems

- (153) FOA report C53001-H9
 Visual effects of sampling in digital picture processing - a pilot study
 (in English)
 Lena Linde and others February 1980

Two experiments were performed in order to study how sampling distortions due to folding and bandwidth limiting are perceived and affect the image quality. The effect of sampling was studied in two different scenes. In experiment 1 the subjective similarity was estimated between pictures subjected to different combinations of filtering and sampling (the sampling distance between pixels was varied). In experiment 2 the subjective similarity was estimated between pictures containing different quantities of Gaussian noise, which were sampled at different distances. Multi-dimensional scaling of the similarity data using MDSAL technique disclosed that the subjective effects of sampling could occur as several different visual dimensions: non-homogeneous noise (false points), indistinct contours, distorted contours and the loss of pattern elements. The relative importance of the various dimensions was found to be different in different scenes.

- (154) FOA report C59003-H9
 Relaxation training, an experiment at the Military Flying School
 Erland Svensson and others February 1980

Different forms of mental training are used nowadays both in clinical and non-clinical contexts. One non-clinical area is sport. In order to improve performance here, both basic mental training, under which various methods of relaxation are included, and applied training directed towards specific problems, are employed.

The report provides a background to the requirements and applications of mental training and describes the effects as reflected in, eg improved performance. A brief account is given of methods of relaxing, as used in schools, of adult amateurs and of front-rank sportsmen.

It describes an experiment in relaxation training in the Air Force, the immediate object being to discover the effects on conditions of interest to the Air Force.

The results can be summarised to the effect that they fail to confirm any casual connection between relaxation training and, eg various changes in performance. Several explanations of this are discussed.

M INTERDISCIPLINARY STUDIES AND INVESTIGATIONS

M3 Security aspects of environmental studies

(155) FOA report C10148-M3
Earth resources
Eskil Block

(in English)
January 1980

For several years the author has been studying the scientific press to discover trends in the growth of knowledge which may affect the human condition and the international balance of power on the Earth. For the Swedish press he has monitored and reviewed the literature on this subject and has travelled and attended conferences in Europe and the USA. The results of these studies have been published in *Nya Perspektiv*; articles include space policy, geology and climate. In a double number of the series, *Current Questions in World Politics* issued by the Institute of Foreign Policy the author has summarised the material and supplemented it with chapters on scientific theory and some fundamental questions of research policy. The article appeared as No.1978:5-6 under the title 'Jordens Resurser'. This English translation was produced in response to international interest.

The purpose of the article is not to give a mathematical model of the flow of raw materials in the world economy, but to present a balanced picture of the efforts of research towards a more efficient and economic use of raw materials. This article deals with the location and extraction of raw materials from *inanimate* nature. The corresponding problems concerning *animate* nature will be covered in a forthcoming report. This leaves the treatment of raw materials in the processing industries, thereafter in the consumer industries, trade, consumption and in the handling of waste and recycling. The author hopes that these different departments of knowledge can subsequently be fused together and applied to the construction of a refined economic model, with the assistance of expert economic opinion. For interested readers the author has added a list of references to the subjects concerned.

M8 Joint research and study projects

(156) FOA report C10150-M8
Rapid calculation of $\sin(x)$
Staffan Wrigge and others

(in English)
March 1980

The article discussed approximations of the form

$$\sin(\pi x) \approx \sum_{n=1}^k c_n [x(1-x)]^n \quad \text{and} \quad \sin(2\pi x) \approx (1-2x) \sum_{n=1}^k d_n [x(1-x)]^n .$$

The coefficients are calculated by using the L_2 norm. Some interesting properties of the associated matrices are proved. Relations to the Jacobi polynomial $P_n(p, q, x)$ are established. In conclusion the approximations are compared with other methods of calculating the sine function.

- (157) Report SP 1978:5 (EFI/FOA)
 Transport and transport research - a look ahead
 B. Schwarz and J.E. Svensson

The point of departure for planning the project was the assumption that an improved view of the requirement for research and development (R&D) in a subject can be obtained by some form of interdisciplinary long-term planning or analysis of the future development in the particular field. It was also felt that by some such future-oriented planning the project might offer some contributory information to the debate on transport policy.

In this study of the future, transport is taken to mean the carriage of both goods and persons, and both personal and collective means of transport. One of the early chapters contains a general systems analysis of the transport sector and its role in the development of society, together with objectives and their formulation in the field of transport. The directly future-oriented section of the study is contained in chapters 4-6. They deal among other things with some possible technical developments of importance from the point of view of transport, but also with certain aspects whose purpose is to afford a general overview of those features of the future development of society which may be of importance to any future wishes or requirements in the transport sector.

The project was conducted as part of a research program intended to construct an expanded methodology in the field of sectoral future studies and long-range planning. The project can also be regarded as a contribution to the accumulation of knowledge concerning the relation between sectoral planning and the planning of R&D.

The book, which is a reprint of TFD publication 1978:7, may be ordered from FOA 1 reports centre (or from EF1).

- (158) Report SP 1979:2
 District heating from nuclear power stations - greater efficiency or greater rigidity? An analysis of method
 Ingemar Lekteus

This report is a study forming part of a project concerning energy and freedom of action funded in the financial year 1978-79 jointly by the Delegation for Energy Research and by the Delegation for Systems Analysis of the Research Council. The report deals with problems of methodology in connection with the structuring of information for decision-making, which has some very long-term consequences. The problems are illustrated by an analysis of an inquiry into district heating from Forsmark.

The report was prepared under the research program for Systems Analysis and Planning (EFI/FOA).

T CERTAIN MEASURES FOR LIMITATION AND CONTROL OF ARMAMENTS

T1 Seismological multiple stations

- (159) FOA report G20333-T1
 International seismological data centre. Demonstration facilities in Sweden
 (in English)
 Ola Dahlman

January 1980

In order to facilitate the institution of an international worldwide seismological monitoring system to verify an agreement which also prohibits underground nuclear explosions, Sweden has offered to instal and operate an International Seismological Data Centre.

A demonstration facility for such a data centre has been built at the FOA Seismological Observatory in order to show one possible means of performing the most important duties of such a centre. This demonstration facility was shown on 12-14 July 1979 to representatives and seismological experts from 26 countries and the World Meteorological Organisation. This report provides a general description of the demonstration facility and a summary of the experience hitherto gained from operating the facility.

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