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ROYAL AIRCRAFT ESTABLISHMENT

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March 1977

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**SWEDISH DEFENCE
RESEARCH ABSTRACTS 76/77-1**

by

Research Institute for National Defence, Stockholm

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ROYAL AIRCRAFT ESTABLISHMENT

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2 Trans. from Research Institute for National Defence, Stockholm (Sweden),
by F. W. Read.

Translator

Translation editor

F.W. Read

M.G.B. Weedon

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EDITOR'S SUMMARY

The Swedish Research Institute for National Defence issues a quarterly list of unclassified Reports published by the Institute. The titles of these Reports, and informative abstracts, have been translated into English. This volume is the first issue of 1976/77. 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 P Rapportredaktion, 104 50 Stockholm 80, Sweden

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See reference 56.

A3 Effects of nuclear explosions

See reference 21.

A5 Injuries and treatment (Atomic)

(1) FOA report B40037-A5

Genetic effects of acute and chronic irradiation with 14 MeV neutrons. (In English).

K-G. Lüning and others

February 1976

CBA male mice were exposed to 14.5 MeV neutrons either at acute (150 or 250 rad) or chronic irradiation (250 rad) levels, and the genetic effects of the irradiation were compared. No observable differences as regards mutation frequency occurred between acute and chronic exposure to 14.5 MeV neutrons. Extract from Acta Radiol, Vol 14, pp 401-416, 1975. FOA reprint 1975/76:27.

(2) FOA report B40039-A5

Influence of oestrogen on the excretion of strontium 90 and 85 in mice. (In English)

C. Rönnbäck and A. Nilsson

March 1976

Groups of CBA male mice were treated with oestrogen hormones exclusively or together with ⁸⁵Sr and ⁹⁰Sr. Retention of strontium was measured in particular parts of the skeleton and also by computation for the whole body. After a period of increasing bone weight the mice treated with oestrogen and ⁹⁰Sr showed signs of a serious breakdown in the newly formed oestrogenous bone tissue. There was no case where the retention of strontium was higher in animals treated with both hormones and ⁹⁰Sr by comparison with those treated with only ⁹⁰Sr. The lifespan of mice that had received the combined treatment was reduced. The results support the theories that cell populations which are simultaneously irradiated and stimulated, are subjected to higher risks of induced tumours, and also that the damage due to irradiation is not solely related to the dose of irradiation in the physical sense.

Extract from Acta Radiol, Vol 14, pp 485-496, 1975. FOA reprint 1975/76:33.

(3) FOA report B40040-A5

Ultrastructure of ⁹⁰Sr induced osteosarcomas and early phases of their development. (In English)

A. Nilsson and others

March 1976

The ultrastructure of radio strontium induced fibroblast and osteoblast osteosarcomas and early stages of their development, have been examined in CBA mice. The material was classified by optical microscopy in eight different stages of development. Minute structural changes were established such as folds in the nuclear membrane, hypertrophy of nucleus and nucleolus, deranged chromatin separation, increased number of polysomes and mitochondria etc. Virus like particles were detected rarely in obvious tumours. Their role as 'chauffeur' or 'passenger' is discussed.

Extract from Acta Radiol, Vol 13, pp 107-128, 1974. FOA reprint 1975/76:34.

B PROTECTION - BIOLOGICAL

B4 Indication and identification

- (4) FOA report B40036-B4
 Technical requirements for luminescence analysis.
 A Thore.

Analysis of cell components by the exploitation of luminescence analysis is of potential interest in clinical microbiology and clinical chemistry. Among other things the use is dependent upon the high sensitivity attained and the suitability of the analysis procedure to easy automatisation or mechanisation. The report discusses the following systems:-

Firefly luciferase (determination of adenosinetriphosphate ATP).

Bacteria luciferase (determination of nicotinamide-dinucleotide, NADH).

Luminol (determination of haematin compounds).

The kinetics of the respective luminescence reactions are discussed, especially in relation to available reagents, together with measuring apparatus. The report includes a review of literature with comments on 18 equipments for measuring luminescence as described in the literature.

Extract from Kemisk Metodik and analysteknik inom sjukvården 1980-1990.

STU-Information No.38, 1975. FOA reprint 1975/76:19.

- (5) FOA report B40054-B4

The interaction of wheat germ agglutinin with keratan from cornea and nasal cartilage. (In English)

H. Carlsson and others

August 1976

Lectins are proteins extracted from plants or lower animals, which have the capability of specifically binding certain carbohydrates. The property of lectins to agglutinate has been used for some time in blood group serology for identifying red blood corpuscles. It is also used for the structural analysis of microbial antigene carbohydrate containing macromolecules, such as polysaccharides or glycoproteins etc, where lectins are used in methods such as precipitation and precipitation inhibition.

Techniques involving lectins can be used for specific purification of sugar containing macromolecules and smaller particles in liquids. The lectin is often bound in an insoluble carrier which technically facilitates the purification procedure. This method has recently been used for partial purification of virus from the myxo- and paramyxo virus groups, for example influenza, measles and para-influenza.

Lectins can also be used for diagnostic applications. In bacteriology for example, lectins are used for the recognition of antigenes including the rapid diagnosis of staphylococcal antigenes.

In the present work a lectin (wheat germ agglutinin WGA) has been used for the first time to precipitate desulphated keratin sulphate of bovine origin. The experiment has confirmed the structure of the keratin sulphate and the binding specificity of the lectin. WGA has previously shown reaction with antigenes from for example, micrococcus luteus and staphylococcus aureus. Preliminary experiments have shown reactivity between WGA and diplococcus pneumonice polysaccharide. The specificity of these reactions is under investigation at present.

- (6) FOA report B40057-B4
 Enzyme linked immunosorbent assay, ELISA. (In English).
 G. Gvall and H. Carlsson October 1976

Coupling antigenes or anti-bodies to an enzyme reagent, results are obtained which permit quantitative measurements of the antigene or anti-body. The method is based on the same principles as the radio-immunological measuring methods (RIA) with the difference that the marker is in the form of an enzyme.

Sensitivity and specificity of ELISA are wholly comparable with RIA. The ELISA reagent is however, more stable and the activity measurements are obtained by spectrophotometry. ELISA is therefore also well suited for automation.

The method has hitherto been used for quantitative measurements of for example, proteins, glyco-proteins and lipopolysaccharides. Furthermore the proportion of specific anti-bodies has been determined in different experimental anti-gene - anti-body systems. ELISA has already been applied in human medicine for serological diagnosis including different infectious illnesses. The immunoenzymatic measuring methods amount to a good alternative to many of the traditional diagnostic tests.

- (7) FOA report B40059-B4
 Ingestion and survival of *Y. pseudo-tuberculosis* in HeLa cells.
 Å. Bovallius and G. Nilsson November 1976

In order to study the interaction between intracellular bacteria and host cells, HeLa cells were infected with *Yersinia pseudo-tuberculosis* for periods of 0.5 to 3 hours. Intracellular bacteria could be established by three different techniques: determination of viable bacteria (viable count), immunofluorescence technique and electronmicroscopical technique. The bacteria appeared to be absorbed by the cells via a phagocyte-like process. The intracellular bacteria existed in cytoplasmic vacuoles some of which increased in size as a function of time. The infection kinetics were studied after adding 10^7 or 10^9 bacteria per cell culture (2×10^6 cells). After a period of approximately 30 minutes a linear absorption of bacteria took place for 1 to 2 hours until most of the bacteria had been absorbed or an upper limit of absorption had been reached. This upper limit could be calculated as an average of 60 bacteria per infected cell. More than 90% of the cells in a cell culture could be infected and bacteria could survive intracellularly for several days.

C PROTECTION - CHEMICAL

C1 Consideration and appraisal of the threat of chemical warfare.
Forecasts and summaries.

- (8) FOA report A40017-C1
FOA reports on chemical protection techniques during 1966 to 1975.
A comparison.

J. Santesson

August 1976

A catalogue of the principal atomic and chemical reports connected with research into chemical means of warfare issued by FOA during 1966 to 1975. Also included are certain biological and ammunition reports. The reports are grouped mainly according to subjects.

C2 Chemical warfare characteristics and effects

See references 9 and 10.

C6 Injuries and treatment (chemical)

- (9) FOA report B40030-C6
Biochemistry of cholinergic receptors. (In English).
E. Heilbronn

Extract from P.G. Waser (Ed) Cholinergic Mechanisms, Raven Press, New York, 1975, pp 343-364. FOA reprint 1975/76:24.

- (10) FOA report B40031-C6
Acetylcholine turnover in mouse brain in vivo, studied with a mass fragmentographic technique. (In English).
B. Karlén and others

Extract from P.G. Waser (Ed), Cholinergic Mechanisms, Raven Press, New York, 1975, pp 99-105. FOA reprint 1975/76:25.

- (11) FOA report B40041-C6
 Effect of cyanide antidotes on the metabolic conversion of cyanide
 to thiocyanate. (In English)
 L. Frankenberg and B. Sörbo March 1976

The excretion of thiocyanate in the urine of mice has been examined after injection of equi-toxic doses of cyanide into untreated animals and animals previously treated with different cyanide antidotes.

The results show that cyanide injected into untreated animals or animals previously treated with thiosulphate, was to a large extent transformed into thiocyanate. Animals previously treated with sodium nitrate or a combination of nitrate and thiosulphate, excreted the given cyanide in the form of thiocyanate, to an even greater extent, which indicates that cyanide which initially reacts by binding to methaemoglobin was finally transformed into thiocyanate.

Earlier treatment of the animals with cobalt compounds (cobalt (II) chloride or dicobalt - EDTA) or a combination of cobalt compounds and thiosulphate, resulted on the other hand, in less relative transformation of cyanide into thiocyanate. The cyanide which reacted because of rapid binding, as a very strong cobalt cyanide complex, is excreted instead with the urine, which could be confirmed by the establishment of large amounts of cobalt ions and the strong complex bound cyanide in the urine from animals that had been given both cobalt compounds and cyanide. A method is described for the determination of cyanide in the form of a cobalt cyanide complex, and its use in chemical forensic investigations is discussed.

Extract from Arch. Toxicol., Vol 33, pp 81-89, 1975. FOA reprint 1975/76:35.

- (12) FOA report B40048-C6
 Production and characterization of antibodies to atropine.
 (In English)
 A. Fasth and others

Extract from Acta Pharm. Suec., Vol 12, pp 311-322, 1975.

FOA reprint 1975/76:37.

D AMMUNITION AND WEAPON TECHNOLOGY

D1 Technology of explosives

- (13) FOA report C20132-D1
 Investigation of an accidental explosion when casting explosive
 substances in building 93 at Ursvik. 27 January 1976
 S. Lamnevik and H. Snäll August 1976

The explosion occurred when casting a mixture of trotyl, hexogen, cesium nitrate and aluminium and caused a small building to be destroyed.

The investigation shows that the probable cause can be assigned to the accidental application of water to the molten explosive substances and that reaction by the aluminium then took place.

- (14) FOA report C20133-D1
Detection and analysis of explosive substances.
A. Alm

August 1976

The report gives a survey of literature on current activities in the field of explosive materials. The contents of this wide range of 400 references have been classified in a number of tables and include high sensitivity analysis methods and instruments for the detection of trace elements, analysis methods in the laboratory, analysis of ingredients, impurities and products of decomposition. Some of the articles thought to be of greater interest, have been briefly described and discussed.

D2 Gunnery technology and associated ballistics

- (15) FOA report C20130-D2
Report on a Service visit to Canada and USA.
S. Nordström

August 1976

The author visited Canada during October/November 1975 visiting the following institutions:- Defence Research Establishment Valcartier (DREV), Quebec. The Ballistic Research Laboratories (BRL), Aberdeen Proving Ground, Maryland. Naval Surface Weapons Centre (NSWC), White Oak, Silver Spring, Maryland. Arnold Engineering Development Centre (AEDC), Arnold Air Force Station, Tullahoma, Tennessee. NASA Ames Research Centre, Moffat Field, California, all in USA.

The purpose of the visit was to study and discuss external ballistic testing of artillery projectiles, concentrating on the instrumentation and evaluation of experiments with aeroballistic trajectories.

Over all the places visited, the ballistic ranges included different designs from large, open ranges of the Nordbanan type, to enclosed hypersonic ranges for tests at high, and more importantly, low pressures. All these ranges differed from ours in that the equipment for photographic recording of oscillatory motion and flow along the course was more highly developed.

Flash apparatus was discussed with the instrument people at the different establishments and sketches or drawings of flash installations in operation, were obtained at several stations.

The evaluation technology for stability tests was also discussed and resulted in cooperation mainly with Ames Research Centre.

The measuring methods for external ballistics used in Sweden were described and our use of Doppler radar for the determination of drag aroused

considerable interest since this method is not used in America. In return several stations demonstrated their measuring system where the measuring data was telemetered from a projectile over most of its course in flight. This method is not used by us to any appreciable extent mainly because of the cost.

Arising from talks on future development trends for artillery ammunition, a number of new types of projectiles under development were shown some of which had very special shapes.

The question of Swedish membership in the Aeroballistic Range Association was taken up with a number of people. The 'misunderstandings' which had hitherto prevented us from applying for admission to this special Association may now be considered as explained away and a Swedish application would now be treated with goodwill.

Certain literature was exchanged and promised.

- (16) FOA report C20137-D2
Approximate determination of projectile movements in a pressure wave damper for 30 mm AKAN, M/75.
R. Renström September 1976

The projectiles' movement relative to the centre line of the pressure wave damper has been studied. It was particularly observed that at firing the relative transverse displacement induced between the projectile and damper did not result in appreciable change in the normally designed clearance between projectile and damper. The change in normal clearance was found to be less than 10%, see Fig 8, page 27. For determination of the projectile displacement, measurements of shot distribution at 80 m distance were used. This showed that up to 90% can be assigned to the direction of the gun barrel muzzle relative to the projectiles' passage in the muzzle.

Further studies have also been made regarding the course of the gas dynamic changes in the damper. The condition of the driving gas in the gun barrel muzzle during the projectiles passage through the muzzle has been calculated, from which the influence of different initial conditions in the damper can be established.

- (17) FOA report C20138-D2
Calculation of the mechanical strains in a 30mm HE shell due to hoop stresses at maximum pressure in the weapon.
R. Renström September 1976

The external forces on the shell are discussed and the dynamic effects are considered. It is pointed out that the hoop stresses cause sufficient mechanical distortion to result in a significant increase in flow boundaries.

With the aid of finite element calculations it is shown that the maximal drag strains in the shell case, due to the hoop load can be substantial.

It is also shown that the tension in the shell case at maximum pressure, is probably not the only cause of fracture as regards the specified standard material for shell cases.

It does show however, that the stress levels are so high, that in unfavourable cases, for example, if only small defects exist in the shell case material, a fracture can be initiated in it due to the hoop stresses which later on at maximum pressure, could lead to complete breakdown and cause the projectile to rupture.

D3 Rocket engine technology and associated ballistics

(18) FOA report C20135-D3

Report on the International Conference at Poitiers, France, October 1974, on "The properties of hydrazine and its use as a source of energy".

Å. Hjertstrand and P. Granbom

September 1976

The Conference was arranged by "Groupe de Recherches de Chimie Physique de la Combustion" at Poitiers University and Centre National d'Etudes Spatiales in cooperation with the European Space Research Organization. The Chairman of the organization committee was M. L. Bernard, Professor at Poitiers University and Director of GRPC. The Conference was well organized and well conducted. Professional simultaneous interpretation English/French was provided. There were 136 delegates from 13 countries and 35 lectures were presented during the following sessions:-

- The more important European research and development activities concerned with propulsion by hydrazine.
- The physical and chemical properties of hydrazine.
- Catalyst.
- Systems used in satellites.
- Applications on the ground.
- Propulsion systems using catalytic or thermal decomposition.
- Space technology.

In conclusion, there was a round Conference on the CNESRO-catalyst for very low thrust in space applications.

(19) FOA report C20136-D3

Report from 'Nortemps-75' the 4th Nordic high temperature Symposium at Helsingfors, June 1975.

Å. Hjertstrand

September 1976

Finland was the host country for this Conference which was previously held in Stockholm 1966, Oslo 1969, Risö (near Roskilde) 1972.

There were three invited general lectures on the first day of the Conference. On the second day there were two parallel sessions covering metallurgy - chemical and physical with 13 and 11 lectures respectively. The third and last day consisted of one session with six lectures on physical metallurgy.

Representatives from West Germany, Norway and Denmark delivered the invited lectures and the remaining 30 lectures were contributed by 16 authors from Sweden, 11 from Finland, 9 from Norway, 7 from Denmark, 3 from England, 2 from Italy and 1 from Switzerland.

The Conference reflected the interests of the commission (Chairman Professor M. Tikkanen and Vice Chairman Professor Veikko Lindroos), who concentrated the selection on metallurgy where Finland has made outstanding contributions. Several of the Conference delegates thought that the technical engineering aspects and applications should have had a greater part in the programme.

Of the 104 delegates, 65 were from Finland, 19 from Sweden, 10 Norway, 8 Denmark, 1 England and 1 from West Germany.

The English language was used throughout. The Conference arrangements and execution were well planned and carried out.

The present Report summarizes the lectures with the authors' own abstracts or extracts from the text of the lecture.

D4 Technology of war and effect on the combatants

(20) FOA report C20129-D4

Destruction of roadway culverts with two charges.
L. Westerling

August 1976

There is a great need to be able to destroy wide road culverts without having to tamp the ends with sand, grass or such like. In order to ascertain if a given tamping effect can be obtained an explosive charge with high speed detonation rate outside and one with a low detonation rate inside at the middle of the culvert, has been calculated by means of a rough, simplified unidimensional model. The calculations showed no improved effect with this method compared with the method using a single charge of explosives.

D6 Protection against the effects on the combatants

(21) FOA report C20126-D6

Heat radiation from petroleum fires. (In English).
B. Häggland and L. Persson

July 1976

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Heat radiation from MC-77 fires have been investigated. The side dimension of the square fire site was varied from 0.5 to 10 meters. Both the

spectral and the total radiation intensity from the flame zone and their dependence on the depth of the flame were measured. The total radiation intensity increased with the depth of flame and reached the maximal value of 13 W cm^{-2} with the flame width of 150 cm. When the bowl is further increased in size significantly lower values were measured depending on the flame zone being masked by smoke.

A method using an IR camera to measure the radiation distribution over the flame zone is described. Finally a simplified method is given which is based on measured data, for calculating the radiation field round the fires of liquid fuel.

- (22) FOA report C20131-D6
Ignition of wood fibre discs by hot fragments.
L. Altvall

August 1976

Hot splinters and fragments from bombs, shells etc can cause fires in houses and the countryside. This investigation deals with the problem of determining the temperature required for fragments to ignite wood fibre discs.

The experiments were intended to try out an experimental procedure, to investigate the effect of the size and shape of the hot fragment and to suggest approximate values for the required ignition temperature.

In the case of steel fragments with plane bottom surface and wood fibre discs as the material to be ignited, a variation in the necessary fragment temperature was obtained from 600° to 800°C when the weight of the fragment varied between 100 and 1 gram.

D7 Injuries and treatment (splinter, blast and burn wounds)

- (23) FOA report B1330-D7
Differentiated reticulo endothelial system (RES) function in some critical surgical conditions. (In English)
B. Schildt and others

Extract from Acta Scand. Chir., Vol 140, pp 611-617, 1974.

FOA reprint 1975/76:31.

- (24) FOA report B1331-D7
Plasma substitute induced impairment of the reticulo endothelial system function. (In English)
B. Schildt and others

Extract from Acta Chir. Scand., Vol 141, pp 7-13, 1975.

FOA reprint 1975/76:32.

- (25) FOA report B1332-D7
Estimation of RES phagocytosis and catabolism in man by the use of ^{125}I -labelled microaggregates of human serum albumin. (In English)
R. Bouveng and others

June 1974

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A method is described for the quantitative determination of both the phagocytosis and the catabolism function for the reticulo endothelial system in man (RES). The method uses microaggregates of human serum albumin labelled with ^{125}I as the test substance. The non poisonous and non antigene substance is quickly absorbed by the phagocytes (the half time being 9.1 ± 0.5 min in 14 normal men) after intravenous injection. By separating and measuring the low molecular catabolites as protein free ^{125}I radio activity in a series of plasma tests, the catabolism decomposition rate can be quantified (the protein free ^{125}I radio activity is doubled after 17.2 ± 0.8 min). A computer program has been worked out to facilitate these calculations. The aim is to find a suitable method for separating protein bound and free ^{125}I radio activity respectively to compare with the following methods:- perchlor-acid precipitate, sephadex chromatography and membrane ultra filtration. The first method, which is both accurate and simple to carry out, was preferred. This method for investigating the RES function has been used successfully in the study of patients during both general anaesthesia and patients in a critically ill condition due to surgical invasion.

Extract from J. Reticuloendothelial Soc., Vol 18, pp 151-159, 1975.

D8 System studies

(26) FOA report C20125-D8

GIPZ - a portable program package for simple graphics. (In English)
T. Ström July 1976

GIPZ is a program system in *FORTRAN* for simple graphic data treatment, for example, simple line drawings or data analysis.

The system contains subroutines at very high level (from a user's point of view) and is written with a flexibility between computers and terminals in mind.

The report describes *GIPZ* from a design and users view point. Program lists are not included.

(27) FOA report C20140-D8

The calculation of a body volume in a practical description of '*VERKSAM*'.
A guide book for three computer programs.

G. Neider September 1976

This is a user's handbook for a program package designed to calculate the volume of bodies in *VERKSAM'S* practical description. The packet comprises three programs which can be used with computer DEC-10. Program *VOLVOL* calculates the volume and surface for each body together with a corresponding value for its sides. In conclusion, a comparison is given of all calculated volumes where the volumes are exclusive of any stated bodies inside. Besides arbitrary convex

polyhedrons with the special 'box' and 'axles' case, the program also solves straight circular cylinders. Although the program permits desired error allowances for the value of corner coordinates, certain polyhedrons create problems. In these cases program *POLVO2* is available which operates in dialogue with the user. The user can clarify and adopt input data via a terminal in order to calculate the volume. Each run with both programs gives a new resulting file. By means of the dialogue program *PRENVO* the files are replaced by a current resulting file together with a current comparison of results. The program is numbered 382 in FOA 042 program archive.

E CONDUCT OF WAR - INFORMATION AND COMMAND TECHNIQUES

E1 Reconnaissance and location

- (28) FOA report B30014-E1
Performance of a photo-ionized CO₂ TEA-laser seeded with organic vapours. (In English)
E. Daniels and others

The properties of a TEA-laser with a flash lamp photoionized gas ingredient has been studied. Many organic materials were suitable as a gas ingredient. Optimal output power was obtained with xylene. Laser emission was observed for all lines from P(8) to P(30) in the 10 mm band when one resonator mirror was replaced by a grid. Numerical calculations have been carried out to estimate the influence of the excitation parameters on electron density obtained in the laser volume. A maximal output energy of 440 mJ was obtained in a 0.15 μ s pulse of 10.59 μ m wavelength (P(20)) for 1:1:1 mixture of He/CO₂/N₂ at atmospheric pressure.

Extract from *Physica Scripta*, Vol 13, pp 12-16, 1976. FOA reprint 1975/76:26.

- (29) FOA report C30075-E1
Digital processing of multispectral data. (In English)
T. Orhaug and S. Åkersten July 1976

The report is a comparison of methods for the computerized treatment of multispectral information for remote analyses. Technical points are discussed with respect to computer configuration, memory requirements and input/output units. Different methods for treating pictures are discussed starting from more general origins. Also discussed is an automatic analysis of picture information by exploiting multispectral data from a theoretical and applicability point of view.

- (30) FOA report C30077-E1
Probing the atmospheric boundary layer with vertical sodar.
B. Holmgren and others July 1976

The report presents a general description of the theoretical and practical background for vertical measuring systems in the atmospheric boundary layer by means of sodar (acoustic radar). Emphasis is laid on applications within the flying weather service. With vertical sodar a continuous picture can be obtained of the turbulent structures within the boundary layer from a lower height of about 25 m, to the highest height varying between 500 and 1500 m. Height and time variations in temperature inversion and zones of wind shear can be observed and convective cells near the ground can be indicated. Also, the magnitude of a convective boundary layer can be established in those cases where an upper limiting temperature inversion gives rise to a band echo on the recording. A very important practical application of vertical sodar deals with the supervision and height determination of the upper half of mist and clouds, for example in the preparation of short term forecasts. Starting from current ground temperature one can also exploit sodar recordings so that a reconstruction in time and space can be made from regular radio probings with more representative temperature profiles over the sodar observation site for both statically stable and unstable temperature layers.

- (31) FOA report C30079-E1
 Analysis of rainfall data from Stockholm during 1973.
 S. Wickerts and K. Östberg

June 1976

In 1973 equipment was tested by FOA for the determination of rainfall intensity. The rainfall intensity for short periods of time (one minute) has not been observed in this country except sporadically. Such information is however, of great importance in many military and civil connections, for example, in the determination of the risk of false target settings by radar target seeking equipment, for planning of radio links on frequencies above 10 GHz and the dimensioning of water run-off systems.

The results of analysis now presented are to be regarded as examples of how such values can be manipulated in practical studies.

It will be noticed that the material has been collected from a rather unrepresentative place namely the roof of a 10 storey building, where the wind conditions could have resulted in the rainfall collected being only a part of the real rainfall over the collecting receptacle. Furthermore the series of observations only extends over one year which is altogether too short a period for a climatic basis. Measurements have been made during both snowfall and rainfall. The report describes only two different types of analysis namely:-

Distribution function and mean duration of the rainfall intensity.

Statistics of initial and maximal intensity during a 20 minute period.

E2 Communications

(32) FOA report A30007-E2

Multipath propagation in hilly terrain for VHF and UHF: general assumptions and recommendations.

L. Ladell

August 1976

In the transition from today's analogue technology to future digital technology certain problems are expected involving propagation paths. It is mainly the limitation in data coverage caused by multipath propagation due to reflection in hilly terrain from irregular formations, for example steep mountain sides, which must be solved. The communication systems most concerned are portable and vehicle borne military radio in the frequency band 30 to 76 MHz and the multichannel telephone/telegraph radio links at frequencies of 450 and 900 MHz.

Following a review of literature which mainly deals with propagation inside large towns, a model is presented for the calculation and determination of the multipath components field strength after reflection over hilly terrain. The model is applied to different situations which illustrate how the input parameters influence the multipath components' field strength.

The report concludes with recommendations based on results from the calculation model. From these it was considered that the risk of multipath distribution interfering with military radio of 30 to 76 MHz was very small and probably not measurable for the system. In the case of the radio link with directive antenna, two frequencies 450 and 900 MHz and two antenna heights 10 and 20 m, were analysed. The risk of interference by multipath propagation is greatest in the case with vertical polarization, antenna heights at 10 m and frequency of 900 MHz, but was also significant at 450 MHz. The risk is least in the case of horizontal polarization, antenna height at 20 m and frequency of 450 MHz, but is only slightly greater at 900 MHz. The calculation model gives the extent of the risk region in the same way as for map reconnaissance and may be combined with reconnaissance in the existing terrain making it possible to eliminate many disturbances of the multipath type.

(33) FOA report C30078-E2

Directional coupler designed in microstrip.

L. Wernlund

July 1976

The report is an account of work done on directional couplers designed in microstrip at FOA 342. The report deals with couplers of the hybrid ring and branch line types, as well as inter-guide couplers. The emphasis of the report is on the different limitations in performance of the directional couplers when they are used as integrated microstrip circuits with thin film technology.

E4 Guidance, navigation and target characteristics

- (34) FOA report C20134-E4
Spin stabilized or fin stabilized projectiles, some simulations.
E. Ulén August 1976

Starting with FOA report C20114-E4 with the same title, some simulations have been made of the simplified model for the spin stabilized conditions. These confirm conclusions made in the main report.

- (35) FOA report C20139-E4
Theoretical studies of body-fixed inertial navigation systems.
K. Olsson September 1976

The report deals with theoretical studies of inertial navigation with body-fixed sensors. The mathematical connection between directly measurable quantities and the desired quantities is examined. Different algorithms for solving these mathematical connections are investigated partly by direct analysis and partly by simulation on computers. On the basis of these studies of the measuring problems in question, different measurement strategies have been developed and some alternative system configurations are outlined. These system configurations can be used later for instrumentation of the system comprising both improved hardware and programs of a system for use with computers.

E7 System studies

- (36) FOA report C30050-E7
Computer program for simulation of multisensor target following by means of Kalman filtration.
A. Bengtsson August 1976

A study has been carried out to establish the Kalman filter characteristics in automatic target followers as part of a multimode target sensor environment. In order to simulate this a system of computer programs has been produced. This report documents the program which simulates the target follower by means of Kalman filtration. The result of the study is given in a special FOA report entitled "Multisensor target following in air traffic systems with the aid of Kalman filtration" No.C30038-E7. The program system is written in *FORTRAN* for computer DEC system 10.

- (37) FOA report C30080-E7
Search capacity of a hydrophone system.
L. Mossberg August 1976

This report describes a study of the search phase of a more complete problem complex which also examines the reliability of a sensor system and how this influences the capacity of the system to first of all, seek out and discover a target and then follow the subsequent target movements.

These questions have been mentioned in Morskoj Sbornik No.3, 1974, FOA special information SO No.6, 1974 and FOA report D30034-E1, October 1975.

The present report examines an American model, which is probably used as a prototype in Morskoj Sbornik and makes the use of that model understandable. An expression for the relative velocity coefficient K_v in Morskoj Sbornik, is derived. The American basis is confirmed by the use of numerical data for current American hunter sonar systems, in the Russian article.

F VEHICULAR AND SPACECRAFT TECHNOLOGY

F3 Aircraft

- (38) FOA report C20124-F3
Investigation of the resistance of two epoxy based carbon fibre composites to isopropyl nitrate.

A. Wirsén and J. Erikson

July 1976

Composite material manufactured from two types of epoxy impregnated carbon fibre (prepreg) namely DX-210, A fibre, and HC 3501, HM-S fibre, have been examined with respect to their bending modulus, breaking strength in shear, and change in weight before and after immersion in isopropyl nitrate at 60°C.

No significant effects could be observed on the material after 24 and 96 hours exposure (bending modulus) and 72 hours exposure (shear breaking strength test) respectively. All values of the confidence level (95%) overlapped each other.

The change in weight is negative (weight reduction) and hardly measurable. This can be interpreted as a very slow soaking of the moulded surface layer.

- (39) FOA report C20128-F3
Investigation into the effects of a projectile on a carbon fibre composite. Situation report.

E. Halloff

August 1976

Sheets of carbon fibre composite manufactured from prepreg (HT-S/HC 3501, Courtauld Ltd) were the target of spherical projectiles. The extent of the visible damage, ie the hole due to the ball or crushing damage and delamination depends among other things on the rate of impact by the projectile, its impact angle and its weight.

It appears from previous experiments that the visible damage was of less extent when the composite sheet was struck by 8mm projectiles than when it was struck with 6mm projectiles at the same speed within the interval of 60 to 1200 m s⁻¹ and attack angle of 90°. The limiting speed for the projectile to penetrate in the case of 8mm balls, was approximately 90 m s⁻¹ and for 6mm balls was about 100 m s⁻¹. A few experiments with similar projectiles as above

but with an angle of impact 30° or 60° were carried out which showed that the hole in the case of a right angled impact was round, and those at 30° and 60° were oval in shape. In addition, it appears that the angle between the direction of the fibre in the outer layer at the front of the sheet and that on the projection of the projectile path on the rear sheet, influences the extent of damage. The damage is greater when the fibre orientation is at right angles to the projected course of the projectile than when the directions are co-planar.

G RELIABILITY AND LOGISTIC TECHNOLOGY

G3 Storage

(40) FOA report C20127-G3

The storage stability of benzine. Induction periods for oxygen gas consumption and comparison with the amount of resin measured.

G. Åqvist

August 1976

In connection with attempts to find a method for predicting storage stability of benzine, some samples of benzine were stored under different conditions. Changes in quality have been monitored hitherto by determination of amounts of resin. This report describes a measuring apparatus for accurately recording consumption of oxygen gas during the oxidation in the experimental benzine and for the determination of induction periods from these measurements. Recordings of the oxygen gas pressure can be obtained from the same tests as for determination of resin and are a valuable complement to this. The mechanism of oxidation of benzine is also involved in the possibility of defining a relative inhibitor concentration from the induction period.

H HUMAN FACTORS

H1 Summaries, forecasts and system studies

(41) FOA report B56001-H

A note on measuring human functions in systems. (In English)

B. Bergström and M. Gillberg

Measurements of human performance capacity in different system functions are usually not readily comparable. Certain functions can be studied however, using measurement units corresponding to β and d' of Signal Detection Theory. The necessary assumption for this is that the information can be expressed in a binary form and that the result depends on a subjective 'certainty value' which varies unidimensionally. Examples of the measuring method for a hypothetical system are given; the system consisting of three functions, detection, identification, and interpretation.

LT

1915 Extract from Scand. J. Psychol., Vol 17, pp 61-64, 1976. FOA reprint 1975/76:40.

H2 Field technique and hygiene

- (42) FOA report C54006-H2
 A gradient free laboratory reactor for catalytic gas reactions.
 P. Granbom and R. Walter September 1976

A gradient free laboratory reactor has been constructed in FOA for the study of heterogeneous catalytic gas reactions.

The report gives a description of how the reactor functions and its performance regarding elimination of concentrations and temperature gradients. From this reactor's characteristics and known correlations for fixed beds, the linear speed of the gas over the reactor's catalytic bed, can be calculated and from it, possible matter and heat transfer resistance through the gas film over the catalyst.

The reactor is part of a complete system for studies of reaction kinetics performed by feeding the reactors in ppm proportion, automatic evaluation of collected data and a unit for the production of ideal step changes in concentrations.

- (43) FOA report C54007-H2
 Chemical risks to health.
 W. Thorsell September 1976

An introductory lecture for safety inspectors and senior safety delegates on the risks to health, commissioned by FAMK in the Spring of 1976 with discussions added in an Appendix.

- (44) FOA report D54004-H2
 The temperature rise in closed standard shelters with or without fire outside. A sensitivity analysis. (In English)
 Å. Bränd-Persson September 1976

A computer program has been prepared (see FOA report A1527-76, March 1971, by B. Martensson and I. Lill) in which the influence of different factors on the possible occupation time for a standard shelter have been studied. The parameters examined were:- the degree of heat transference, the number of persons per m² floor area, the number of partition walls and the shelter dimensions. The time to attain a maximum allowable temperature of the shelter air of +30°C (dry thermometer) at 95% relative humidity was selected as a criterion for the internal climate reached in the shelter.

Calculations have been made for a summer and a winter condition, without ventilation, the outdoor temperature for summer being +18°C and 90% RH and for winter -5°C with 90% RH.

The results indicate that the possible occupation time, without fire, during the summer, is about 2 hours and during the winter about 24 hours. In

the case of fire outside the shelter (on the roof) the possible staying time becomes less than 2 hours for both summer and winter conditions.

H3 Body function with change in the surrounding pressure

- (45) FOA report A59001-H3
Investigation into the suitability of personal flying equipment.
L. Larsson and R. Andersson September 1976

Service experience, comments and desirable objectives have been collected with the idea of preparing a basis for modifications and/or further development of personal flying equipment, emergency equipment and flight harness with arrangements for connection to aircraft seats. Information communicated to FMV-F resulted in a request to FOA 590 to seek solutions for improved comfort, better protection and availability according to the following:-

- (1) Improvements in clothing including underclothes, insulating dress with or without head hood, together with clothing ventilation. The objective being to improve comfort and protection against cold, moisture and heat (including protection against fire).
- (2) Optimal survival packs and the contents of first aid provisions.
- (3) A new examination of breathing gases to find the most suitable composition in order to avoid frequent complaints about irritation in the ear and throat after flying.

H5 Injuries and treatment, rehabilitation and associated activity

- (46) FOA report B54002-H5
A new technique for the long term stable measurement of energy expenditure. (In English)
U. Danielsson and others

A technique to determine energy consumption is described. It is particularly adapted to measurements on patients of low activity. The technique for analysis and calibration of continuous tests is new. Calculations of energy consumption and the working out of results were obtained from a table calculator. Extract from Burns, Vol 2, pp 107-109, 1976. FOA reprint 1975/76:38.

- (47) FOA report B54003-H5
The elimination of hypermetabolism in burned patients - a method suitable for clinical use. (In English)
U. Danielsson and others

Hypermetabolism can be eliminated when the patient with burn injuries receives regular supplies of heat from infrared heaters. The energy consumption, corrected for fever, was independent of the burns' extent and depth. The energy expenditure was studied during the daily treatment routines.

LT

1915 Extract from Burns, Vol 2, pp 110-114, 1976. FOA reprint 1975/76:39.

H6 Performance capacity and conduct including group factors and leadership, mainly under war conditions

(48) FOA report C55003-H6
Some essential features in the positivist philosophy, with examples from psychology and sociology.

B. Starrin

September 1976

This report outlines the essential features in the positivist philosophy with examples from psychology and sociology. The heart of this philosophy is the idea that natural scientific methods without anything else added, can be used in other sciences for example, psychology and sociology. In order to understand this idea, positivism must be treated from an historical viewpoint. The natural sciences during the 1800 period and beginning of the 1900s, had made great progress. One of the causes of this was thought to be the method used by natural scientists. This method with its possibilities for making exact determinations, began to force itself into such disciplines as psychology, sociology and economics. Seen from a scientific historical perspective, this was sound. Philosophy and psychology were burdened with ideological and metaphysical appraisals which were difficult to associate. However, the positivist scientific method was raised to a general law. That which could not be expressed in figures was not worth knowing. The almost magical overtones on quantitative methods are less interesting than the scientific ideal behind them. The positivist ideal set up rules as to how scientific research should be pursued and what should be considered as good research. Positivist research became synonymous with 'the scientific method'.

The debate now going on about social scientific research indicates that the supremacy of positivism is about to break down. Before a new scientific ideal is promoted to universal solution, factors such as scientific understanding, human vision and perspective, should be subjected to a critical discussion.

H7 Examination and choice of personnel

(49) FOA report C55002-H7
The connection between estimates of the psychological enlistment variables and the results of training No.1 at the 2nd Platoon Command School 73/74.

G. Wellius

August 1976

The object of the present investigation was to find grounds for judging the capacity of the psychological enlistment examination to forecast progress in the unit, ie their validity. The investigation group has been carried out by all students that have completed their training No.1 in the 2nd Platoon Command School 73/74. The connections between reports after the completed training and the psychological enlistment variables have been calculated by means of product

moment correlations and step by step multiple regression analyses. For the regression analyses the output criteria consist of the different reports and the total scores of the reports, whilst the input variables consist partly of the psychological functioning drawn from the psychological enlistment variables, suitability to command an experimental group and partly on the above named variables subvariables. A factor analysis has been carried out to establish to what extent the psychological variables and the reports are influenced by the same factors.

The results of the regression analysis show that E comprises the first step and S, the subvariable to B, comprise the second step in the majority of criteria. The highest connection occurring is between psychological variables and reports valid for No.1 and reports in personnel proficiency. With Pf, B and PGR as input variables, Pf comprises the first step in the analyses for all criteria and explains a fairly large part of the variant, whilst PGR and B explain a very small part. The result of the factor analyses show that two factors have a high connection with the subvariables to B and Pf, a third factor has high connection with No.1 pattern tests and a fourth factor shows high connection with the report after completing training. The psychological variables and reports also comprise weighting to a fairly high degree in separate factors.

H8 Training procedures

(50) Command work motivation. A method study.
A. Paulsson

October 1976

The report gives a description of a method for collecting information with the object of compiling data on the functioning of individuals. The method has been used in an attempt to illustrate command work motivation. The function conditions have been established by interviews where the commander spontaneously relates situations and events which form the starting point for the analysis. 65 officers from three units were engaged in the study. Certain conclusions about their work motivation have been derived by means of an estimating procedure where their present working conditions are contrasted by their function conditions. For continued use of the method better arrangements for data collection are needed.

H9 Man and machine interactions

See reference (45)

M ASSOCIATED STUDIES AND THEIR SOLUTIONM3 Predictive planning

- (51) FOA report B11015-M3
Technological change and disposability of inputs. (In English)
R. Färe and L. Jansson

A CES-function and a WDI-function have been adapted to a time series for the German economy during the years 1850 to 1911. In the first approach Hicks neutrality is accepted, in the second a number of possible choices of contributions are permitted that give positive production varying with time. Both the functions are in good agreement with the observations but technological changes are explained in different ways.

Extract from Z. Nationalökonomie, Vol 34, pp 283-290, 1974.

FOA reprint 1975/76:28.

- (52) FOA report B10016-M3
On VES and WDI production functions. (In English)
R. Färe and L. Jansson

Structures of production with weak but not strong disposability are characterized in terms of the cone which represents a unit of equal sides. The substitution elasticity for such WDI production functions is shown to be non-monotonal.

Extract from Int. Economic Rev., Vol 16, pp 745-750, 1975.

FOA reprint 1975/76:29.

M4 Systems and program planning

- (53) Some aids to program development. The simulation packet *MIMIC*, program language *RTL/2* and *CORAL 66*. Report from a study visit to England.
B. Carlsson and I. Widegren August 1976

A study visit to England was made mainly to study investigations at Time Sharing Ltd (TSL) and to obtain experience with the program development packet *MIMIC*. This packet which is developed for operation on a DEC system 10, is used to develop and test programs written in assembly language for a number of small computers. *MIMIC* is considered to be useful for FOA in particular cases, particularly for system programming. The costs to buy and hire *MIMIC* are high with respect to its usefulness. (If necessary *MIMIC* can be used via terminal connections with TSL in London.)

During the study journey visits were made to the Royal Radar Establishment (RRE), Malvern, where the program language *CORAL 66* and the latest compiler development for this on DEC system 10, were discussed. The structure of the new compiler provides a good precedent for the development of interacting compilers.

CORAL 66 is developed and distributed by a number of institutions and undertakings.

At Systems Programming Ltd (SPL) in London, we had a halfday discussion on program language *RPL/2*. It mainly dealt with compiler construction, development, distribution and standardization requirements. The *RPL/2* language and the compiler construction are like *CORAL 66* in many respects. However, the *RPL/2* compiler in certain respects, is more modern and probably better from the viewpoint of effectiveness. *RPL/2* is developed and distributed by SPL.

N MILITARY ENGINEERING RESEARCH

(54) Deformation of metal membranes by static and transient loads.

A theoretical model. (In English)

S.A. Granström

September 1976

The report reviews studies of ideal membranes subjected to transient loads. The studies show that both oscillation periods and maximum deformations can be described with outstanding accuracy by two simple calculated values: (a) the time taken for the marginal disturbance to reach the centre of the membrane and (b) the way in which a free disc exposed to even pressures over its surface, is displaced during the corresponding time. The actual vibration time of the membrane and maximum deformation are obtained by smaller additions (often less than 20%) to the magnitudes described. The relationship is shown to be closer for rectangular membranes. Some of the results are given for construction purposes, in a special tabulated form. The membranes' successive deformation and final form, with loading for different pressure/time sequences and durations, are described in systematic diagrams for circular and rectangular membranes.

Calculations based on the results, for ideal membranes but with prerequisites of certain specified restrictions to be satisfied, have been made which are also valid for plastic sheet membrane. Experiments which have been carried out and which verify this assumption will be described in later reports.

T POSITIVE MEASURES FOR LIMITATION AND CONTROL OF ARMAMENTS

T1 Seismological multiple stations

(55) FOA report C20093-T1

Earthquake in Guatemala, 4 February 1976. (In English) February 1976

This report presents the seismological measurements made at FOA observatorium in Hagfors from an earth tremor in Guatemala on 4 February 1976.

The report contains the recorded short and long period signals and their spectra.

T2 Collection and analysis of airborne radioactivity

- (56) Radioactivity from nuclear explosions in ground-level air at three Swedish sampling stations. Ge(Li)-measurements up to mid year 1975.
(In English)

R. Arntsing and others

August 1976

Measurements with Ge(Li) detectors of radio active nuclides from ground level air tests are reported for the period up to July 1975, from three Swedish sampling stations, Ljungbyhed, Grindsjön and Kiruna. Values are given for Ljungbyhed from April 1974, for Grindsjön from August 1972 and for Kiruna from August 1973. The principal sources of the particle bound radio activity during the period under review, were the Chinese nuclear weapon tests in March 1972, June 1973 and June 1974.

The activities dealt with were ^7Be , ^{54}Mn , ^{88}Y , ^{95}Zr , ^{103}Ru , ^{106}Ru , ^{125}Sb , ^{131}I , ^{137}Cs , ^{140}Ba , ^{141}Ce , ^{144}Ce and ^{155}Eu .

EMERGENCY COUNCIL FOR PSYCHOLOGICAL DEFENCE

- (57) BN report No.75

Youth and defence.

K. Törnqvist and K. Aggefors

September 1976

The first part of this report describes a comparison between the attitudes to defence in the Autumn of 1975 of youths and the whole population. The aim was to study whether the outlook of youth had undergone any changes during the last year; whilst the second part of the report is a comparison between the results of 1971 and 1975 youth investigations. In addition, the results of a new question which applies to youths' attitude to a liability to military service by a call-up in his mobilization locality after orders by radio following an outbreak of war.

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