

APPENDIX 5A
ANALYSIS OF FAILURES

1. QUESTION

(a) Too detailed:-

(1) 30-06. The question "What is the average decrease in gas consumption per horse power hour for reciprocating engines in the course of their history", was taken from an article entitled "The economics of large aircraft". The article was seven pages in length, yet the part upon which the question was based consisted of a single sentence:

"It must be remembered that the gas consumption of reciprocating engines used to be 1/10th of a gallon per horse power hour which amounted to 0.6 lb per horse power hour, and yet today, this has been reduced to almost half this figure."

The document remained untraced in all systems.

(2) 70-09. The question on recommended dimensions of masks for chemical milling of aircraft structures was taken from an article entitled "Modern methods of aircraft production". As the title suggests, the article reviewed many methods of manufacture and one short paragraph dealt with one particular method. Such a specific question, which, incidentally, could not be answered with any degree of satisfaction, would not be expected to trace a general review article.

The document remained untraced in all systems.

(3) 36-11. With a question "Supersonic drag of a parabolic nose cone", the document remained untraced in all systems, because the question was too specific for the material contained in the article. The questioner apparently took his question from the list of illustrations. There would be many more documents which would help the enquirer rather than this one, which contained so little on the specific subject. Only unrealistic indexing would have revealed the document.

(4) 58-15. With a question on the theoretical calculation of flutter of a cone at hypersonic speeds, the question was too specific in that it refers only to two paragraphs on the next to the last page of a ten-page article. The article referred to flutter of various aerodynamic shapes, which would have involved much detailed indexing if the indexer had included each shape mentioned. However, although cones were referred to, they were not mentioned in the summary. There would not have been sufficient material to help the enquirer when there are so many more documents specifically on the subject.

The document remained untraced only in U.D.C., partly because of lack of permutation, but was traced in the other three systems because of the approach via flutter and hypersonic flow.

(5) 70-11. The question "Use of an oil film technique to determine flow patterns at low Mach numbers", was based upon a single sentence in the main body of the report, which was also repeated in the summary. The document was about a particular high speed tunnel test of the effects of combined nose droop and outer-wing chord extensions on a $7\frac{1}{2}\%$ thick swept wing. The fact that an oil-film technique was used, was only briefly mentioned, and there was insufficient detail to help an enquirer posing this question. The document remained untraced in all systems.

(6) 70-14. A question "What factors limit the thickness of a panel which may be chemically machined and what are the advantages of this process over mechanical machining processes", was based on a single paragraph of a fifteen-page document. It is very doubtful whether the information contained in the paragraph would have been any help to the enquirer, as only two advantages of chemical machining over mechanical machining were given, those of cost and accuracy.

The document remained untraced in all systems.

(b) Too general:-

(7) 24-09. "Calculation of damping in roll at supersonic speeds". This question was based on a document entitled "The second-order lifting pressure and damping in roll of sweptback rolling airfoils at supersonic speeds".

The document was not traced in the Alphabetical system because the question proved too general for the scheme. As it was usual during the indexing programme to index as specifically as possible, the document was indexed under 'aerodynamic shape', with aerodynamic characteristic as subheadings. The question referred only to the aerodynamic characteristic - therefore the document remained untraced. Unless all subheadings are also used as main headings, thereby almost doubling the size of the catalogue, this situation will always arise. However, in real life situations, sufficient documents would have been found which treated the subject generally, to satisfy the enquirer.

(8) 41-06. "Boundary layer displacement effects". This question was based on a document entitled "Boundary layer displacement effects in air at Mach numbers of 6.8 and 9.6. The document was sixty-one pages in length, and went into detail about tests on pressure gradient and skin friction drag of flat plates and low drag wings. The indexer was allowed sixteen minutes, and hence made many entries, but she did not index the title. If the time allowance had been two minutes, possibly the title alone would have been indexed and the document traced.

However, in such an aerodynamic collection, the question would have brought forth many documents which would have satisfied the enquirer. The question is too general for the content of the paper, even though it was taken from the title.

The two concepts 'Boundary layer' and 'Displacement' cannot be expressed in U.D.C., except under 532.526 'Boundary layer'. This section consists of hundreds of cards. In Alphabetical, the heading BOUNDARY LAYER - Displacement is quite adequate. The Facet system is the same as U.D.C., in that only 'Boundary layer' can be expressed at Nfk. In Uniterm, of course, both concepts can be used.

Although the concepts could be adequately placed in Alphabetical and Uniterm, the question is still far too general to trace the required document in all systems, without bringing out hundreds of other documents.

(9) 45-08. The question on "The effect of roughness on skin friction" is too general for an aerodynamic collection. There are many articles written on the subject, any of which would satisfy the questioner, unless he were able to be more specific. The document title was "Turbulent boundary layers in adverse pressure gradients". If the concept 'turbulent boundary layer' had been added to the question, the document would have been traced without difficulty.

The document remained untraced in all four systems.

(10) 56-07. The question "Value of model testing for predicting instability of structural elements" was too general because the type of structural elements was not defined. The title of the document upon which the question was based is "Study of size effect on sheet-stringer panels".

The document remained untraced in U.D.C., Facet and Uniterm, but was found in the Alphabetical system because of the zealous approach of the searcher. Her train of thought led from MODELS, STRUCTURAL, to PANELS - Stability, then to PANELS, ALUMINIUM ALLOY, and finally SHEETS, ALUMINIUM ALLOY. Presumably, the searcher thought that, as aluminium alloy panels and sheets were very frequently discussed in articles, these headings were the most likely.

(11) 57-10. The question "High strength alloys" was based on the document entitled "High strength aluminium casting alloy 40E:DTD 5008: latest developments and foundry experience". It is obvious from the title that this article discusses a specific aluminium alloy - hence such a very general question is quite inadequate. The question would have been answered by many articles, or better still a chapter from a general book on metallurgy, or one of the ASM series.

The document was traced only in the Facet system because the searcher was also the indexer - and knowing that she had indexed several articles on high strength aluminium alloys, she checked under Peel-a in the classified sections. Many other documents were also retrieved.

(12) 65-06. "Structural stresses at which plastic flow occurs". This question was based on a document entitled "Practical solution of plastic deformation problems in the elastic-plastic range". The document was a NACA Technical Note of thirty-three pages of text, concerning plastic deformation of four types of structure, (a) a flat plate, (b) a thin shell, (c) a solid cylinder, (d) a rotating disc. Naturally, the indexer decided that these types of structure should be indexed, rather than giving one general heading covering 'structures'.

The only real concept received by the searchers was 'plastic flow'. 'Structural elements' was too vague to be useful. In U.D.C., the document was traced at the second attempt under 539.374 (Plastic deformation). In Alphabetical it was traced at the third attempt under DEFORMATION, PLASTIC, and in Uniterm it was found under 'Stresses' and 'Plasticity'. The searcher in Facet failed to trace the document, partly because of the form of the chain index, which gave fifty-six places to check under Rip (Plasticity) and also because the question gave only one useful concept. In other words, it was too general for the specificity of the document.

(13) 23-12. A question on the combustion of rocket engines proved too general for Facet. The document was specifically on propellant vaporisation as a criterion for rocket engine design, and gave calculations using various log-probability distribution of heptane drops. Actually the question was too general for all systems, but, in U.D.C., by widening the search to 621.45 (Rocket engines), in Alphabetical by looking under ENGINES, ROCKET - Performance, and in Uniterm, by finding ROCKET: ENGINES: COMBUSTION: PERFORMANCE, the document was traced.

In Facet, the searcher tried 33 entries containing 'rocket engines' and 'combustion'. She then abandoned the search, because to check under 'rocket engines' throughout the whole chain index, would have been too arduous and general a search.

Permutation of the Facet entries would have equated this system with the others.

(14) 64-11. The question "Investigation of flutter problems at high speed", proved too general for Facet. The searcher refused to check in the chain index under these two single concepts. With permutation, and adequate indexing, such a question should not involve a long and tedious search.

(15) 71-06. The question "Jet deflection by auxiliary air injection", proved a general one for an aerodynamic collection. There are many papers and articles indexed that include material on the subject. The deflection of jets could refer to theoretical studies, or one of the many applications, such as jet flaps for the increase of lift on aerofoils.

The document upon which the question was based is entitled "Internal characteristics and performance of an aerodynamically controlled variable discharge convergent nozzle". However, in spite of the generality of the question, and the specificity of the document, it was traced in Alphabetical, at the fourth attempt under JETS - Application, and at the second attempt in Uniterm under the same concept.

U.D.C. and Facet searching failed to trace the document, because of the number of places to check under 'Jets' in U.D.C. and also in Facet under 'Applications of jets'. With further explanation of the question, the document could have been traced in each case.

(c) Not easily understood:-

(16) 69-10. "The ratio of virtual shear stress to laminar shear stress π^* is a measure of instability which occurs because of what".

This question was based on a document entitled "The heating of slabs with arbitrary heat inputs". The question is very complex, and the only entry into the catalogue is via the concept 'shear stresses'. It is a question, which, if presented to a librarian in a working library, would require explanation. One would want to know if there were any particular metal or component in which the shear stresses occurred.

When actually reading the one-page article, one finds that it is mostly concerned with a method of solving the heat conduction equation. 'Shear stresses' are not mentioned anywhere in the article, were not indexed by the indexer, and hence not traced in the searching.

The question failed on all four systems.

(17) 30-12. A question "What is meant by a moulded harness" failed in all four systems, because the searcher could get no clue from the question where to start the search. If the questioner had been available, the searcher would have been able to get more information from him. As it was, the only attempts were under 'safety harnesses'.

(18) 38-14. A question "Means by which the pilot of a military aircraft may achieve the maximum possible time in combat from his aircraft", proved a failure in all systems. The document was about range prediction, and discussed the parameters of fuel quantity, altitude, ambient air temperature, and their effect on range prediction.

The failures were due in part to lack of understanding by the searchers, but were also due to a rather ambiguous question.

(d) Misleading:-

(19) 46-10. The question "Thermal decomposition of solid AN by a high flux heating technique", was considered by the searchers to be misleading. From the article entitled "The gasification of solid ammonia nitrate", it is obvious that AN refers to ammonia nitrate. However, AN is not a recognised symbol for ammonia nitrate. The searcher in Alphabetical and Facet guessed the meaning of the abbreviation, and so traced the document, but the searchers in U.D.C. and Uniterm had no idea of the meaning. It is confusing to use such an abbreviation, which can easily be mistaken for a typing error of the chemical symbol A_n - Actinon. The fault was not that of the questioner, as the author used the same abbreviation in his text.

(20) 63-08. The question "Three dimensional boundary layers on slender wings", proved misleading to the searcher, but in U.D.C. and Uniterm the document was traced. In U.D.C., the searcher tried 532.526.2 (Laminar boundary layer): 533.693 + (wings of all types). The document was traced under 533.693.31 (Delta wings).

In Uniterm, three Uniterms were successful 'Wings', 'Boundary' and 'Layer'. This was considered a success.

The document title adequately explains the subject - "An approximate method of calculating the laminar boundary layer on a delta wing". Admittedly the delta wing referred to in the article is thin, but the term 'slender' in this context usually is associated with thin low-drag wings, and has been so interpreted by the searchers.

(21) 77-06. The question "Performance of engines with liquid injection" proved misleading. Three of the searchers understood that fuel injection was implied and limited their search programme to include this aspect. The fourth searcher immediately checked the correct place 621.438.057.3 (Water injection system. Gas turbine engines).

If the question had read "water injection" instead of "liquid injection", the document would have been found in all cases.

(22) 24-12. The question "Heat transfer and pressure drop of flow in pipes", can be considered misleading in that it refers to a very minor section of the paper. It cannot be considered too detailed because of the non-specificity of the question.

The article was entitled "Comparison of wall effects on supercavitating flows past symmetrical bodies in solid wall channels and jets", and was almost entirely concerned with cavitation flow in pipes. The concept of heat transfer was implied, but not mentioned in the paper, whilst there was brief mention of the effect of pressure.

(23) 65-13. The question "Reynolds stresses in two-dimensional parallel boundary layers" was misleading in that the concept 'boundary layer' was not mentioned in the article. However, as the document was about parallel flow between parallel planes, the concept of boundary layer was implied.

The document remained untraced in all four systems.

(24) 67-13. The question "Effect of incidence on pressure distribution on upper surface of 6% thick RAE 101 section with long bubble", remained untraced in all four systems because the searchers were misled by the aspect "RAE 101 section", which led them to limit their search to 'Aerofoil sections' and 'Aerofoils'.

Actually, there was no mention in the article of any type of aerofoil section by name, other than NACA 63009 and NACA 0006 series, under which presumably, RAE 101 is included.

(e) Incorrect:-

(25) 38-06. The question on the measurement of screech in rocket engines was actually incorrect. The document entitled "Study of screeching combustion in a six inch simulated afterburner", dealt with a comprehensive investigation on turbojet afterburners.

In the first paragraph of the paper, the author gave a summary of the work already done on the study of screech, mentioning screech in rocket engines. That is the only time that rocket engines is found in the whole of the paper. The questioner apparently read the introduction and understood, incorrectly, that the whole of the paper dealt with this aspect.

The document remained untraced in U.D.C., Alphabetical and Facet, because the searchers insisted upon 'rocket engines' being a necessary concept. The searcher in Uniterm was satisfied with 'noise' and 'engines' as the only two Uniterms to be successful.

(26) 75-06. The question "What are the aerodynamic characteristics of an 'arrow-wing' at high Mach numbers", was also incorrect. The paper, entitled "Idealized wings and wing-bodies at a Mach number of 3", as the title suggests, referred to supersonic flow, and not hypersonic flow, as suggested in the question. Hypersonic flow is usually considered to cover Mach numbers from five upwards.

The searchers in U.D.C., Facet and Uniterm insisted upon 'hypersonic flow' in their search programmes, and so failed to trace the document.

The searcher in the Alphabetical catalogue, after trying WINGS, ARROWHEAD, HYPERSONIC: WINGS, ARROWHEAD: WINGS, HYPERSONIC, found the document at her fourth search under WINGS, SUPERSONIC. This was a rather overzealous approach and so cannot be counted a true success.

(27) 78-10. The question on supersonic rotational flow with attached shock waves is quite incorrect. It was based on a document entitled "An investigation of the pressure distribution on the conical bodies in hypersonic flow". The article is two pages in length, and contains no reference to shock waves and also refers to hypersonic and not supersonic flow. There is no mention of rotational flow. The flow referred to is around cones. On checking with an aerodynamicist, he stated that rotational flow may, in some cases, be conical.

The document remained untraced in all four systems.

(28) 38-13. A question "Satisfactory welding conditions for experimental production joints in steel titanium", has a misprint. The question refers to sheet titanium. If the question had been correctly phrased, there would have been little difficulty in searching. The document was not traced in U.D.C. or Uniterm.

2. INDEXING FAILURES

(a) Insufficient indexing:-

(i) Personal errors

(a) Omission of an important concept:

(29) 38-13. The indexer ignored the aspect of the effect of helium on the diffusion fields of laminar boundary layers. He indexed 'flat plates' and 'laminar boundary layer' but did not mention helium.

The document was traced in U.D.C. by checking under the whole section 'laminar boundary layer' at 532.526.2. In Uniterm 'diffusion' had been added, and so sufficient Uniterms were found to be a success.

(30) 38-08. In an article on the measurement of pressure distribution on thin bodies, the indexer made only general entries under 'Measurement of pressure distribution' and 'Static pressure tubes'. He did not realise, or at least, failed to index the concept 'thin bodies' on which the importance of the paper hinged. The particular method of measurement described was devised for 'thin bodies' because their pressure distribution is difficult to measure by the more conventional means.

In U.D.C., the document was traced under 'Pressure tubes' at 533.6.082.3 and in Uniterm under 'Measurement: Pressure: Distribution'.

(31) 36-10. The indexer ignored 'Surfaces' in an article on "Forced convection over arbitrary surfaces". It is agreed that the adjective 'arbitrary' infers that any shape, or type of surface can be intended, but, as there is little other than 'Convection', or 'Heat transfer' to index, the concept of 'surface' should have been included. (This is substantiated by the search programme). The document was traced in U.D.C. because of inversion of entries - found under 536.25 Convection.

(32) 26-08. In an article on plate theory and analysis of stresses on plates, the indexer ignored the first concept. In Alphabetical there is a heading 'PLATE THEORY' which could have been used, and, in Facet, Ffe (Plates) + Xs (Theory) could have placed the concept. In U.D.C. the document was traced because there was no place for 'plate theory'. Thus the searcher knew that he had to check under Plates 621-415 + 530-539 Physics. As there was the recognised heading 'PLATE THEORY' - Alphabetical, the searcher limited his search to this. In Uniterm, sufficient other Uniterms were traced for a success to be considered.

(33) 68-08. The indexer omitted to index 'walls' in an article on the prediction of the separation of a turbulent boundary layer near a wall. This omission caused very general headings to be made under boundary layer separation and turbulent boundary layers. Thus in the Facet catalogue, there were too many entries in the chain index under the two concepts for the searcher to check through. The document was traced in U.D.C. and Alphabetical only after the searcher had checked through the whole section 'boundary layer separation'.

(34) 53-10. In an article on the use of a potential analyser to give the pressure distribution on thin wings, the indexer did not include 'potential analyser'. This term could have been included in the Uniterm system without trouble, and in the Facet system the term 'analogy' would be the most reasonable under which to include the term. If these entries had been made, the document would have been traced.

(35) 50-06. In an article describing testing plant used at the R.A.E. for simulating the effect flight conditions have on airborne equipment, an important part of the text concerned the effect of high altitude. This was ignored by the indexer. If it had been included in all systems, the document would have been traced.

(36) 20-13. The question "Drag divergence Mach number for NACA 23015 aerofoil section" failed in all four systems because the indexer did not index the concept 'NACA 23015 aerofoil section'. He had a time allowance of sixteen minutes, which should have been sufficient to enable him to include this concept.

The article was entitled "Effects of compressibility on the performance of two full-scale helicopter rotors" and included a description of the blades, stating that they were of the particular NACA section. This concept should have been noted by the indexer, and included.

(37) 26-12. The question on measurement of transverse velocities in annular flow between concentric cylinders, caused the document to remain untraced in U.D.C. The document was entitled "Experimental search for the effect of compressibility in unsteady Couette flow".

If the indexer had included the concept of 'annular flow' in all systems, although it would not have affected the results of the search in the other three systems, it would have enabled the document to be traced in U.D.C.

The document was found in Alphabetical because of the ability to index under CYLINDERS, CONCENTRIC - Flow. The same applies to Facet and Uniterm, in that the indexer was able to include this concept. In U.D.C., however, there is no place other than the general heading 'cylinders' at either the aerodynamic number or the material shapes number. Thus the searcher had to fall back on the concept 'annular flow' which had not been indexed.

(38) 31-13. A question "The hydrodynamics of fluid-fluid interaction at the interface of parallel stream" did not trace the required document in Alphabetical or U.D.C. The inclusion of 'interference' with the entries made, would have reduced the search considerably in Facet and Uniterm, and would have enabled the document to be traced in Alphabetical and U.D.C.

In U.D.C., 533.695 Interference, should have been added to 532.526.2 Laminar boundary layer, and in Alphabetical, the addition of the subheading 'Interference' should have been added to BOUNDARY LAYER, LAMINAR.

(39) 64-11. A document on aeroelastic problems in connection with high speed flight failed in U.D.C. and Alphabetical because the indexer omitted the concept of 'hypersonic flow' throughout the system. Had this been included, the search would have been successful in these two systems.

It would not have helped in Facet, unless permutation had been used, as the searcher would still have refused a search from the form of the question.

(β) Too general indexing:-

(40) 64-11 Although there was no mention in the summary to centrebody intakes, the term 'intakes' alone being used, the article was concerned specifically with centrebody intakes. This was ignored by the indexer, who made an entry, in all systems, under the general heading 'intakes'. As in Facet, there was no adjectival phrase 'centrebody' (although Icb 'Centre' could have been used), the searcher found the document under 'Intakes'. In Uniterm and U.D.C. if the more

specific entry had been made, the document would have been traced without trouble.

In Alphabetical, the document was traced because the searcher went back to the general heading 'INTAKES'.

(41) In an article on the methods of manufacturing of aircraft structures, the indexer was not sufficiently specific with his treatment of 'aircraft structures'. Instead of placing them at 629.13.012, he made a general entry under 629.13 (Aircraft). Thus his entries read 'Machining: Aircraft', and 'Workshop practice: aircraft' (also in each case, inverted). If the indexer had used the more specific entry in U.D.C., the document would have been traced.

(42) 70-09. A similar case to example (40) is the omission of 'circular', in an article on the buckling of stiffened circular cylinders. If the term 'circular' had been added in Alphabetical and Facet, the document would have been found.

However, in U.D.C., as there is no specific place for 'circular cylinders' the searcher knew that he would have to go to the section on 'cylinders'. In this section the document was found. In the Uniterm system, sufficient other Uniterms were brought out to consider the search a success.

(43) 20-15. In an article entitled "Aircraft design and mission compatibility", the indexer, with a time allowance of 16 minutes, made only general entries. For the major part of the article, the indexing was sufficient, but a particular example of a turboprop transport aircraft was mentioned, and upon this example, the question was based.

If the indexer had included the concept of turboprop transport aircraft in all systems, the document would have been traced in Alphabetical and Facet. Actually in U.D.C. it was found because the indexer had included an entry under 629.138.5 Transport aircraft. In Uniterm, the terms 'Aeroplanes' 'Weight' and 'Operation' were considered sufficient for a doubtful success. The addition of 'Transport' and 'Turboprop' would have ensured a firm success.

(44) 31-12. With a document on the boundary layer behind shock waves moving in a stationary fluid, it remained untraced in Alphabetical, because the indexer did not use the subheading 'Interference', which is the only one suitable in this instance. (The inability to combine these two concepts of shock waves and boundary layers, is discussed in another section). The searcher decided that a search through the whole section of 'shock waves' was too general, and so after checking under 'Boundary layer, laminar - Interference' and 'Boundary layer, turbulent - interference' the search was abandoned.

Actually, the same applies to the indexer's use of BOUNDARY LAYER, TURBULENT, and BOUNDARY LAYER, LAMINAR, without subheadings. If the same subheading 'Interference' had been used, the document would have been traced at the first search.

(45) 70-13. An article on the design and application of a monopropellant turbo-rocket, mentioned the type of propellants to be used. The indexer made only single, general entries under 'Turbo-rocket engines', and completely ignored the concept of 'propellants'. As he had a time allowance of eight minutes, he should have had sufficient time to make more detailed entries.

As the question read "What single propellants have been used for air-turbo rockets", the searchers were not happy about the search under GJ Rocket engines, nor the Uniterms 'ROCKET' 'ENGINES' and 'TURBINES', but they

considered the results successful.

With the same generality of search in U.D.C. and Alphabetical, the documents were not found, because of the use of new headings (see later discussion).

The addition of 'propellants' to all systems, would have enabled the document to be traced in Alphabetical and U.D.C., and would have considerably shortened the search in Facet.

(46) 70-14. An article entitled "Modern methods of aircraft production", principally referred to machining and press-forming methods used in aircraft structures. However, the indexer, with a time allowance of eight minutes, made general entries under 'manufacture of aeroplanes' - quite insufficient for the scope of the article.

If entries had been made under Panels 621-415 (U.D.C.), PANELS - Machining (Alphabetical), Ffh Qg Machining: Panels (Facet), plus the addition of PANELS to Uniterm, the document would have been traced in all four systems.

(γ) Failure to recognise practical application:-

(47) 70-14. In an article on fuel systems and the control and use of fuel as a coolant for supersonic engines, the indexer failed to recognise the importance of fuel as a coolant. If this aspect had been included in all systems, the document would have been traced.

(48) 44-10. An article on the design and performance of throttle-type fuel controls specifically refers to their application in gas turbine engines. This practical application was not indexed, and, as the words 'gas turbine engines' were included in the question naturally the searchers considered this concept important. The document was traced in Alphabetical under 'Fuel systems', and in Uniterm because sufficient other Uniterms were traced to consider the search a success, but in U.D.C. and Facet, the addition of 'gas turbine engines', would have enabled the document to be traced.

(δ) Lack of technical knowledge:-

(49) 29-08. In a highly theoretical paper on the flow of gases through nozzles, many equations and several hodographs were used. Presumably because of the indexer's lack of mathematical knowledge, he did not recognise the equations used as partial differential equations, and laid emphasis on the hodographs alone. The inclusion of the omitted concept would have enabled the document to be traced.

(50) 65-13. In this article, no specific reference was made to boundary layers, although the concept was implied, and the article was specifically concerned with parallel flow between parallel planes.

The searcher was aware of the connection of the subjects, but did not think through the article to the concept 'boundary layer'. An indexer with more knowledge of the subject would perhaps have automatically associated the two ideas, to make the correct and additional entries.

The document remained untraced in all four systems, as the question was phrased "Reynolds stresses in two dimensional parallel boundary layers".

(c) Effect of one concept on another:-

(51) 65-13. In an article on the frequency of vibration of conical shells, the effect of the vibrations on deformation of the shells was discussed. This aspect was not indexed. If it had been included, the document would have been traced in Alphabetical, U.D.C. and Uniterm.

In Facet, the document was traced because the searcher checked the chain index under 'Conical' (Igr) and looked at all entries in which this adjective occurred.

(b) Overdetailed indexing:-

(52) 31-09. From a very detailed N.A.C.A. Technical Note, the indexer made eighteen Alphabetical entries and has indexed much of the detail contained in the body of the document, which concerned the boundary layer pressure gradient, heat transfer, etc., on low drag wings and flat plates. If, however, the indexer had indexed only the title of the document "Boundary layer displacement effects in and at Mach number of 6, 8 and 9.6", which would have been the full extent of his indexing had the time allowance been two minutes instead of sixteen, the document would have been traced.

(53) 39-12. With a document on the measurement of the aerodynamic forces on oscillating aerofoils, the indexer indexed the example referred to in the text, of 'rectangular wing', plus 'oscillation', etc. As this was an example to demonstrate the measurement of oscillation, etc., a more general entry should have been made.

The question "Methods of measuring force and moment derivatives on oscillating aerofoils", gave unsuccessful searches in U.D.C. and Alphabetical because of the specificity of entry.

However, with additional permutation in U.D.C., the document would have been traced. In Alphabetical, a further more general search would have traced the document under OSCILLATION - Measurement.

Entries under AEROFOILS, OSCILLATING - Forces and moments, (with equivalent entry in each system) would have traced the document at the first search in all systems, instead of after a very lengthy search in Facet.

(54) 48-13. With an article on the thermal stresses caused by transient heating on the stiffness of various wing structures, the indexer made careful entries under the types of wing structure, e.g. AEROFOIL SECTIONS, DOUBLE-WEDGE; AEROFOIL SECTIONS, CIRCULAR ARC, and presumably chose these headings under Aerofoil sections because she was unable to express the qualifying adjectives under 'Wings' (see section under incorrect indexing).

A simple entry under WINGS - stiffness, with the equivalent entry in each system, would have traced the document without difficulty.

The document was traced in the Uniterm system because of the indexer's practice of including the terms in the title, as well as the terms indexed in other systems.

(55) 64-11. A question on the investigation of flutter problems at high speed remained untraced in U.D.C. and Alphabetical because of specificity of indexing in these systems.

The article was one entitled "Aeroelastic problems in connection with high speed flight", and consisted of a review of developments in the field of aeroelasticity in the last ten years. It is the type of article that is best treated by general entries, as there is insufficient detail contained therein on any one particular development to be of interest to an enquirer with a specific development in mind.

An entry in U.D.C. under 629.13.012 (Aircraft structures): 533.6.011.55 (Hypersonic flow), would have been adequate, plus the number 533.6.013.42 (Flutter). In Alphabetical FLUTTER, HYPERSONIC, would have been adequate, with an additional entry STRUCTURES, AIRCRAFT - Flutter.

(c) Incorrect indexing:-

(i) Personal errors:-

(56) 64-11. During the indexing programme the indexers agreed that all two-dimensional aerofoils and wings should be placed at 533.692 (except designated ones at 533.692.1) and all three-dimensional aerofoils and wings at 533.693. Despite this agreement, one indexer gave the headings 'AEROFOILS' in Alphabetical, Cc 'Aerofoils' in Facet, but gave the U.D.C. number 533.692 Aerofoil sections, or two dimensional aerofoils, in U.D.C. Because of this, the searcher, who checked the 533.693 number, together with various combinations, failed to find the document. U.D.C. was the only failure in the four search programmes.

(57) 37-10. In indexing an article on starting flow characteristics of rocket engines, the indexer, presumably because he did not check up the notation in the schedules, placed 'Rocket engines' at Gf (Gas turbine engines) instead of Gj. He obviously intended the document to be placed under 'rocket engines', as this was included in his interpretation of the entry for the catalogue.

(58) 32-06. The indexer when indexing in the Facet system an article on laminar flow, made the mistake of putting Ncf instead of Ncd. Had the error not been made, the document would have been traced with the searcher's second search programme.

(59) 29-12. With a document on boundary layer transition in supersonic flow around a 10" cone, the indexer made entries throughout the system, under 'transitional flow', instead of 'boundary layer transition'. As the question was 'Boundary layer transition in supersonic flow', a very general one, the document was not traced in U.D.C., Alphabetical or Facet.

In Uniterm, the search was considered a success as 'transition' and 'transitional' are the same Uniterms.

(60) 35-14. With a document on an investigation of a turbojet engine with a variable exhaust nozzle, the indexer made entries in U.D.C. under 621.438.018.5 (Performance: Gas turbine engines) instead of 621.438.084.018.5 (Performance: turbojet engines).

Also in Facet, he made the same error by using Gf Gas turbine engines instead of Gg Turbojet engines.

In Uniterm, the indexer also did not use TURBOJET, although there is such a Uniterm.

Presumably these errors occurred because in Alphabetical, TURBOJET ENGINES are included under the heading GAS TURBINE ENGINES.

(61) 39-12. With a document on low speed wind tunnel calibration of a Mk 9A Pitot static head, the indexer in U.D.C., Alphabetical and Facet made entries under 'pitot tubes', although there was a specific place in each system for 'pitot static heads'. As the question was "Pitot static head calibration", the searchers naturally insisted upon checking under 'pitot static heads' in each system. In Uniterm, the indexer did include 'static'.

(62) 48-13. With a document on the thermal stresses caused by transient heating on the stiffness of wing structures, the indexer made entries in U.D.C., Alphabetical and Facet, under 'Aerofoil sections', presumably because in Alphabetical, he was able to express 'double-wedge' and 'circular arc'. Better entries would have been under 'WINGS' and 'STRUCTURES, AIRCRAFT'.

In Uniterm, these concepts were included.

(d) Insufficient number of entries:-

(63) 48-13. From an article on the interaction of oblique shock waves with laminar boundary layers on flat plates, the indexer chose seven U.D.C. places, which adequately covered the subject of the document. From these, he made eight permutations only, bringing five of his seven numbers to the head of the permutations. 'Shock waves' was used only twice, once in combination with 'flat plates' reading thus:-

Flat plates: shock waves: supersonic flow, and once thus:-

Shock waves: flat plates: supersonic flow.

'Shock waves' were never used in combination with 'laminar boundary layers'. If an entry had been made, to read - Shock waves: laminar boundary layer: supersonic flow, the document would have been traced at the first attempt.

(64) 31-08. From an article on the servo-tab system of control, the indexer decided upon two U.D.C. numbers: 621-52 Servo-mechanisms, and 533.694.58 Tabs. From these, he asked for only one entry reading - Tabs: servomechanisms.

He should also have inverted the two numbers, when the document would have been traced.

(65) 68-07. An article on thermoelastic stresses in a thick walled tube had four U.D.C. numbers allocated to it:

- A. 621-462 - Tubes
- B. 539.377 - Deformation
- C. 536.495 - Thermal stresses
- D. 536.5 - Temperature

Three entries only were made, each under 621-462 'Tubes' as first entry. If the indexer had included an entry reading CA 'Thermal stresses - tubes', the document would have been traced. The questioner asked for thermal stresses in a body exhibiting temperature dependent elastic properties, and so the searcher, after two search programmes, checked the whole of the section under 'thermal stresses'.

(66) 67-09. In an article on the heat transfer of a wedge in a supersonic wind tunnel, the indexer chose five U.D.C. numbers which adequately covered the subject of the document. From these five numbers, six entries were made, four of them beginning with 'Wedges'. The question referred to supersonic flow over a step which prompted the searcher to make the first search programme 'Boundary layer separation: supersonic flow'. If the indexer, who included these two concepts in his indexing had made an entry reading - 'Boundary layer separation: supersonic flow: wedges', the document would have been traced.

(67) 56-08. The indexer who indexed an article on the corrosion resistance of stainless steel plates, chose the correct U.D.C. numbers to cover these three concepts, but, again did not make sufficient permutations. He chose four combinations of the numbers, but did not make an entry reading - Stainless steel: corrosion by inorganic acids. He did however, make an entry - Corrosion by inorganic acids: stainless steel.

As the questioner asked for material on the corrosion-resistance controls on the production of stainless steels, the only sure way of finding the information was to approach it via 'stainless steels' + 620.193 onwards (which would include all subdivisions of corrosion).

The indexer should have realised that this type of approach could be made.

(68) 21-09. With an article on the use of a potential analyser to give the pressure distribution on thin wings, the indexer chose the U.D.C. numbers most appropriate (a little difficulty in placing 'potential analyser'), but did not make sufficient entries.

The question referred to 'loadings', which is the more general section under which 'pressure distribution' is placed. Therefore, the searchers' best approach was via 'wings: aerodynamic loadings' (which would include pressure distribution).

If the indexer had made an entry to read - 'Wings: pressure distribution', as well as the entry 'pressure distribution: wings', the document would have been traced.

(69) 50-06. In an article on the effect of thickness, camber and thickness distribution on aerofoil characteristics at Mach numbers up to 1.0, the indexer chose six U.D.C. numbers but only asked for seven entries. The indexer also, in three entries, put four U.D.C. numbers together - causing a very long notation, which is quite unnecessary.

If the indexer had made the following entry - 'Aerofoil sections: transonic flow: forces and moments', the document would have been traced.

(70) 23-13. With a document on the application of similarity rules for transonic flow past slender bodies of revolution at zero incidence, the indexer made entries under:

- A. 533.696.4 Cones
- B. 533.6.011.35 Transonic flow
- C. 533.696.5 Bodies of revolution

The permutations suggested were AB and CB. Although it is not usual practice to make entries under speed of flow, in this particular document, where the similarity rules for transonic flow were discussed, such an entry BA, and BC, should have been made.

As the question asked for material on transonic similarity (laws and methods), with no other concepts, the only place possible for the searcher to try was 533.6.011.35.

(71) 33-15. With a document on magnetohydrodynamic hypersonic flow past a blunt body, the indexer did not make sufficient permutations, to enable retrieval via 'blunt bodies' and 'hypersonic flow' only. (The master card is missing, but as the indexer made entry under BODIES, BLUNT, HYPERSONIC - Flow, in Alphabetical, one presumes that the same concepts were included in U.D.C. Therefore the reason for failure must be due to lack of permutation).

(72) 37-14 A document on the lubrication of journal bearings had the following places chosen in U.D.C. :

- A. 621.822.5 - Journal bearings
- B. 533.69.048.2 - Pressure distribution
- C. 621.822.5-72 - Lubrication. Journal bearings.

The permutations made by the indexer were AB and BA. The concept C was ignored entirely. As the question asked for material on axial variation of pressure in the lubricating film of bearings, the searcher concentrated on 'lubrication' and 'bearings'. (The searcher could have used 'pressure distribution and bearings' as a search programme, but this is considered late).

(73) 38-13. In a document on the welding of titanium sheet, the indexer made the following entries:

- A. 621-415 - Sheet
- B. 669.295 - Titanium
- C. 621.791.765 - Fusion welding

with the permutations ABC : BAC : CAB : CBA.

The question (which actually misprinted 'steel' for 'sheet') asked for "Satisfactory welding conditions for experimental production joints in steel titanium". Ignoring the typing errors the document should still have been traceable from 'titanium' and 'welding', i.e. 669.295: 621.791 +. With a further permutation BCA, the search would have been successful.

(74) 39-11. A document on wind tunnel observations of boundary layer transition on two sweptback wings at a Mach number of 1.61, was untraced, again through lack of permutation. The indexer chose the following places:

- A. 533.693.1 - Sweptback wings
- B. 532.526.3 - Boundary layer transition
- C. 533.6.011.5 - Supersonic flow

with the permutations ABC and BAC.

The question "Method of detecting boundary layer transition in supersonic flow", gave only two concepts for searching. Therefore, if the indexer had made a permutation under BCA the document would have been traced.

(75) 54-12. With a document on the bursting speed of a rotating plastic disc, the indexer made entries under:

- A. 621-415 - Plates
- B. 539.214 - Plasticity
- C. 531.15 - Stresses
- D. 539.319 -Stresses due to technical operation.

The permutation read BAD : DAC : ABC : CAB. A further permutation AD, would have been consistent, and would have caused a success by one of the searcher's search programmes.

(76) 55-14. A document on four methods of measuring the properties of a supersonic boundary layer on flat plates, had the following entries:

- A. 532.526.4 - Turbulent boundary layer
- B. 533.6.011.5 - Supersonic flow
- C. 533.692.4 - Flat plate aerofoil sections.

with permutations ACB : CBA.

The question "Method of measurement of supersonic boundary layer flow", gave only two (or almost two) of the concepts indexed. One of the searcher's programmes, under 'Turbulent boundary layer: supersonic flow', would have revealed the document if permutation ABC had been made.

(77) 56-12. A question "Base pressure behind circular cones at about $M=3$ ", was based on a document on the behaviour of flow behind a blunt base in supersonic flow, and the resulting interaction between shock waves and boundary layers. The indexer made the following entries:

- A. 533.6.015.5 - High altitude
- B. 533.69.048.2 - Pressure distribution
- C. 533.6.071 - Wind tunnel tests
- D. 533.696.5 - Bodies of revolution

with permutations BAC : DAC.

As there was only one concept in common between the question and the indexing, the searcher had difficulty but if a permutation BD had been made, it would have been possible for her to have looked under 533.69.048.2:533.696+.

(78) 58-15. A question "Theoretical calculation of flutter of a cone at hypersonic speeds" failed because the cone was only one of the many aerodynamic shapes mentioned in the article. If the indexer, who made the following entries:

- A. 533.6.011.55 - Hypersonic flow
- B. 533.6.013.422 - Flutter
- C. 533.692 - Aerofoil sections

(with permutations CBA : BCA), had included a permutation BAC, the document should have been traced via the concept 'flutter: hypersonic flow: aerofoil shape (533.692+)'.

(79) 60-12. Although 12 permutations around 8 U.D.C. numbers were made for this document, it remained untraced. The document was on wind tunnel tests of damping in pitch of two-wing-body combinations, one with a triangular wing and the other with a straight, tapered wing. The question was "Does damping in pitch of wing disappear at transonic speeds".

If the indexer had made an additional permutation under 533.6.013.15 (Pitching moments): 533.693.35 (Rectangular wings), the document would have been traced at the searcher's third search programme.

(80) 72-14. A document on the strength in compression and tension of an aluminium alloy extruded angle to specification BS.L.65, had the following entries made:

- A. 669.715-135 (B.S.L65) Aluminium alloy extrusion B.S.L65
- B. 620.172 - Tensile testing
- C. 620.173 - Compression testing
- D. 621-423 - Angle sections

with permutations AB : AC : ADB : ADC : DAB : DAC.

The question was "Tangent modulus for B.S.L65 material in compression". Due to a mistake in indexing the type of alloy, (discussed elsewhere), the document was not found by that approach.

If however, there had been permutation under CA, the document would have been traced by the searcher's approach in 'Compression tests: aluminium alloys'.

(81) 29-07. With an article on the effect of leading edge slats on the aerodynamic characteristics of a 45 swept-back wing fuselage combination, at Mach numbers 0.4 to 1.03, there is plenty to index. In the Facet catalogue, unless a detailed question is asked in the same terms as the indexer indexed the document, such a question involves a long search. It was thought, later on in the indexing programme that shorter and more numerous entries would be more helpful than single, detailed entries.

In this particular failure, the indexer made an entry of nine elements, which, agreed, adequately indexed the document. If, however, he had made two entries instead of one, the document would have been traced, by the searcher's first programme.

(82) With an article on the air conditioning and pressurisation of aircraft cabins, the indexer, in Facet, did not include an entry under Edd 'Pressurised cabins'. He did include 'air conditioning of cabins' at Edb Gug. Had the extra entry been made the document would have been traced without difficulty.

(e) Careless indexing:-

(i) Personal errors:-

(83) 20-06. With an article on ablation and heat transfer on the nose region of a body, the only entries made in U.D.C., Alphabetical and Facet covered 'ablation' and 'cooling'. However, in Uniterm, the indexer included 'blunt' and 'bodies', so he obviously realised that this aspect was important. This should have been added to the three other systems, and would have constituted a success in Alphabetical system.

In U.D.C. the document was traced under 536.422.1 'Ablation', but to find it, the searcher checked the whole system.

In Facet, it was traced via the chain index under 'sublimation' (there being no place for ablation) at the fourth search programme.

In Uniterm, it was traced under 'Heat transfer', 'Cooling' and 'Bodies'.

(84) 21-08. With a report on the design and testing of an axial compressor, the indexer, except in Uniterm, ignored the concept 'design', and made entries under 'axial compressors', 'pressure distribution', 'temperature', and 'tests'.

The document was found in U.D.C. by the searcher checking 'Performance of axial compressors' at 621.438.031.3.018.5. In Facet, it was traced by the searcher checking the whole classified section under Gwd and then the chain index. In Uniterm, the terms 'Compressors', 'Axial', 'Performance' and 'Stages' were retrieved. In Alphabetical, however, COMPRESSORS, AXIAL - Performance and COMPRESSORS, AXIAL - Design, drew a blank. Therefore, if the indexer had included 'design' in U.D.C., Alphabetical and Facet, or included 'performance' in Alphabetical and Facet, the document would have been found at either the first or second search in Alphabetical.

(85) 21-09. In an article on the corrosion resistance of stainless steels, the last aspect was included in U.D.C., Alphabetical and Uniterm. However, in Facet, the indexer limited his entry to Pf 'Steels'. The question demanded information specifically on stainless steels, so, naturally, the searcher decided that he would search only Pfcrmi 'Stainless steels' in the chain index.

If the indexer had been consistent, and included the term 'Stainless steels' in the Facet system, the document would have been traced at the first attempt without difficulty.

(86) 24-06. In the U.D.C. entries for an article on aerodynamic loads of a sweptback wing aircraft, the indexer included the aspect 'Sweptback wing' in all systems but U.D.C. (the only failure). If this had been included, the document would have been traced at the first attempt.

(87) 24-09. In an article on lifting pressure and damping in roll of sweptback aerofoils at supersonic speeds, the aspect 'damping', was included in all systems but Facet. If the indexer had been consistent the document would have been traced under the searcher's third search programme.

(88) 25-08. From an article describing an electrical device for measuring the downwash distributions, the questioner phrased his question "Electromagnetic analogy for downwash". In only Uniterm did the indexer include 'analogy', and this was the only system successful. If 'analogy' had been included in the other three systems, or more specifically 'Electromagnetic analogy', the document would have been traced in all the other systems.

(89) 26-06. In a document which clearly refers to the mechanisms by which hydrogen enters steel, the indexer omitted to include 'hydrogen' in the Alphabetical system, causing a failure. As the question referred to 'metals', instead of more specifically 'steel', the searcher could only approach the question via 'hydrogen' and to have checked through all types of metal would have been unrealistic.

(90) 26-07. An article on reverse flow theories had sufficient information on the effect of supersonic flow for the indexer to include it in Alphabetical, U.D.C., Uniterm, but it was omitted from Facet. As the question read "Reverse flow theories at supersonic speeds", the searcher insisted on 'supersonic'. If this had been added by the indexer, the document would have been traced under the first search programme in the searching of Facet.

(91) 27-07. With an article on the calculation of vibration on different types of cylindrical beams, cantilever and of rectangular cross-section, the indexer indexed all these concepts only in Uniterm. As there is no subdivision of 624.072.2 Beams, under shapes, in U.D.C., the document was traced, from a question demanding material on transverse oscillation of cylindrical beams. However, in Alphabetical and Facet, where there is provision for cylindrical beam, the searchers insisted on this aspect, therefore the document remained untraced.

Had the indexer included 'cylindrical' in all the systems, the result would have been a success.

(92) 27-10. With a detailed paper on flame stability in ducts, an important section dealt with the stability of propane air mixtures. This was noted by the indexer, who included 'propane' and 'gaseous fuels' in Uniterm and Alphabetical systems. 'Gaseous fuels' was included in Facet, but not 'propane', and neither were included in the U.D.C. system - although there was allowance in the schedules in each case. If the indexer had been consistent in all four systems, the document would have been traced.

(93) 30-08. In a paper on the unsteady laminar boundary layer on a flat plate, the indexer, presumably through carelessness, omitted to include 'laminar' as a Uniterm. He could also have added 'unsteady', although this is the only system under which the adjective could have been included. If this had been done, the document search would have been successful.

- (94) 31-06. The indexer who indexed an article on a photoelastic investigation of stress concentrations due to small fillets and grooves in tension, included the concept 'photoelasticity' in U.D.C., Alphabetical and Facet systems, and ignored it in Uniterm. If this had been included, the document would have been traced. Also, an entry under the general heading 'PHOTOELASTICITY' in Alphabetical would have enabled the search to be a success.
- (95) 31-10. With an article on ram-air cooling systems for aircraft generators, the indexer omitted to include 'cooling systems' in U.D.C., Alphabetical or Facet, and in none of these systems was the document traced. The indexer included 'Cooling' in these three systems, but this was not sufficient. Had entries been made in U.D.C., 621-712, instead of adding -712 to the number for generators, therefore, reading 621.313.12:621-712 - Generators - Cooling and inverted, 621-712:621.313.12, Cooling - generators, the document would have been traced. In Alphabetical, an entry COOLING SYSTEMS would have been sufficient, and in Facet, the addition of Gt to the original entry would have made a successful search.
- (96) 33-07. With an article on the effect of stress frequency and temperature on the fatigue of metals, the indexer, except in Uniterm and Alphabetical, ignored the concept 'metals'. The document was traced in U.D.C., by checking under the whole section of fatigue at 539-431, which was a rather too zealous search. In Alphabetical, the document was traced under 'METALS - fatigue'. Facet, however, failed to retrieve the document, because of the omission of Pe - Metals. If this had been included, the document would have been traced. The addition of 669 in U.D.C. would have decided a successful search at the first attempt.
- (97) 39-07. The indexer omitted to include 'solid propellants' in U.D.C., Alphabetical and Facet, when indexing an article which included material on solid propellants, as well as material on the design of rockets. He realised the importance of this aspect, as he included it in Uniterm. Had he not omitted it in the other three systems, the document would have been traced.
- (98) 41-07. An article on a method of optimising aircraft auto-stabilizer systems was badly indexed. The indexer made an entry under STABILISERS, and AEROPLANES, PILOTLESS, in the Alphabetical system, but did not include these concepts in the same form in U.D.C. or Facet. Instead, he entered 'stability of control surfaces'. Had he been consistent, the document would have been traced. In Uniterm, he included 'Pilotless' and 'Stability', but these were the only concepts of the question to be traced. Therefore, the search was not considered successful.
- (99) 46-07. With an article on supersonic flow about slender bodies of elliptic cross-section, the indexer included 'elliptic' in U.D.C., Facet and Uniterm, but ignored it in Alphabetical. If an entry had been made under ELLIPSOIDS, the document should have been traced with adequate searching. This aspect was included in Facet, which also failed to retrieve the document, but because of inadequate searching.
- (100) 51-06. An article on a method for the deflection analysis of thin low-aspect ratio wings was not retrieved in the Alphabetical system because the indexer, although including the essential concepts, did not enter 'aspect ratio' as a subheading under WINGS, although this was allowed.

In the Facet system, the indexer did not include 'Low' (Zqj), although there is provision for the adjective in the schedules. It was included in Uniterm.

(101) 54-07. The failures in this question are rather complex. The indexer omitted, in all systems, to include 'Redux bonding', although the article was on stress fatigue tests on a redux-bonded and riveted double strap joints in 10 SWG aluminium alloy sheet. Had this aspect been included, the document would have been traced in the U.D.C. catalogue at the second instead of the fourth attempt. In the Alphabetical catalogue, a new heading, JOINTS, BONDED, ALUMINIUM ALLOY, would have been necessary. In Facet, the addition of Qkf Redux bonding, would have enabled the document to be traced.

Other reasons, discussed elsewhere, also contributed to the failures.

(102) 60-07. In the Uniterm system, the addition of 'network' (a recognised Uniterm), would have constituted the search a success. The article was concerned with electric networks and circuits. The failure in Facet was due to the search programme.

(103) 68-10. In an article on the effect of turbulent spots on boundary layer transition, it was not traced in the Facet catalogue because the searcher did not include 'Turbulence' at Ojp, although this aspect was included in the other three systems, in all of which the document was traced.

(104) 71-08. In a paper on air conditioning of aircraft, a major section of the paper was concerned with air conditioning systems for the cabins. The indexer forgot to include 'Cabins' in his indexing under the Uniterm system. If this concept had been included, the document would have been traced.

(105) 72-07. In an article on the design of a hypersonic wind tunnel, using ammonia-oxygen as a working fluid, the indexer omitted to include 'hypersonic flow' in his Facet indexing. If this concept had been included the document would have been traced at the third attempt.

(106) 75-08. The indexer did not index the concept 'shrinkage' in any system other than Uniterm. In U.D.C., the document was traced at the fifth attempt under 'Plastics - high temperature' at 678.5: 536.45. If 'shrinkage' at 620.192.52 had been included in the indexing, the search would have been successful at the fourth attempt.

The inclusion of 'shrinkage' in Alphabetical would have made no difference to the failure because of the bad search programmes. In Facet, the document would have been traced at the third attempt.

(107) 20-14. With a document on the adhesive bonding of magnesium alloys, the indexer in U.D.C. made an entry under 669.721, Magnesium, instead of 669.721.5 Magnesium alloys, although 'magnesium alloys' had been included in all other systems.

If the correct entry had been made, the document would have been traced.

(108) 25-12. The concept 'density' at 533.12 was omitted from the U.D.C. entries for a document on the effects of density fluctuations on the turbulent skin friction of an insulated flat plate, although the concept was included in all other systems. The concept was one necessary to the search programmes, and so the document remained untraced in U.D.C.

- (109) 28-15. A document on the manufacture of stainless steel honeycomb structures had no entries in U.D.C., Alphabetical and Facet under 'stainless steel', although this concept was included in Uniterm. Because of this omission the document was not found in any of the three systems. The question was "Use of stainless steel in aircraft".
- (110) 29-13. In an article on the effect of delta vanes on lift of wings in supersonic flow, the indexer did not include 'lift' at 533.6.013.13, although this concept had been included in all other systems. As the question asked for material on the lift of supersonic wings, the document remained untraced.
- (111) 29-14. A document on the design details of a precision potentiometer and ratiometer instrument suitable for use in setting up analogue computers, was indexed in U.D.C., Alphabetical and Facet only under 'Potentiometers'. The concept of 'analogue computers' was included only in Uniterm.
As the question asked for methods of obtaining accuracy on analogue computers, the document was not found except in Uniterm.
- (112) 30-11. In an article on transport aircraft suitable for use to carry fighter planes, etc., the indexer included the concept 'transport aircraft' in all systems but U.D.C. If an entry had been made at 629.138.5 (Transport aircraft) the document would have been traced at the third attempts.
- (113) 32-13. With a document on the study of turbulence, the indexer included entries in Uniterm under 'Turbulence', but not in U.D.C., Alphabetical or Facet. If these entries had been made, the document would have been traced without difficulty.
- (114) 41-14. A document on curved shock waves in three-dimensional gas flows had a question "Expression for vorticity vectors behind the shock waves in three dimensional gas flow".
The concept 'vorticity' was excluded but formed a part of the first search programme. Therefore, if the entry had been made under 532.527, the document would have been traced.
- (115) 43-11. With an article on a mathematical theory of boundary layer transition and fully developed turbulent flow, the indexer included the concept of 'boundary layer transition' only in Alphabetical. Had it been included in the U.D.C., Facet and Uniterm, the document would have been traced.
As the question was "Transition from laminar to turbulent motion", the searcher had no other concept from which to search, other than by checking through the whole sections under 'laminar' and also 'turbulent flow'.
- (116) 49-11. With a document on aerodynamic characteristics including pressure distribution, on wing-body combinations in subsonic flow, the indexer did not include 'pressure distribution' in either U.D.C. or Facet. If this had been done, the document would have been traced under 533.69.048.2 : 533.695.12 with U.D.C., or Ca Cd Ea Nvf with Facet.
- (117) 51-11. A question on "Cooling a supersonic airstream by liquid injection", failed because only in Uniterm did the indexer include the concepts of 'cooling' 'liquid injection'. In the three other systems, he included only 'pressure recovery' 'diffusers' and 'supersonic flow'.
An entry under COOLING, LIQUID, would have been successful in Alphabetical. For Facet the entry should have read Hrm Nbk Stc(Pre).

(118) 54-11. A document on the range performance of aircraft, failed in U.D.C., because the indexer omitted the concept 'Range' in both U.D.C. and Alphabetical. The document was traced in Alphabetical by checking under the heading PERFORMANCE - Calculation.

If an entry had been made under 533.6.015.74, the document would have been traced.

(119) 60-12. In a document on the damping in pitch of wings in transonic flow, the indexer omitted to include the concept of 'damping' in U.D.C. Had this been included, and attached to 533.6.013.15, the document would have been traced.

(120) 66-13. A document on the behaviour of a supersonic jet, representing the flow of exhaust gases from a rocket motor, is studied. The indexer made entries throughout the system on jet mixing, but in only Alphabetical and, of necessity, Uniterm (because one can take out only the Uniterms required), was the aspect of vibration of supersonic jets (as apart from jet mixing) included.

The question was "What is the ultimate width of the jet of a supersonic rocket", and so, the approach was via jets + supersonic flow.

An entry in U.D.C. under 533.697.4 Jets (Internal Aerodynamics) would have enabled the document to be traced.

(121) 67-12. An article on the calculation of pressure loss in baffles used for flame stabilisation in combustion chambers, failed in U.D.C., because the indexer did not make an entry under 'baffles' at 621-712.2. Had this been done, the document would have been traced.

Also, a failure in Facet because of the same concept omission.

(122) 67-13. A difficult question on the pressure distribution on the upper surface of a 6% thick RAE 101 section with long bubble, could have traced the document, if the indexer had included the concept in U.D.C., of 'bubble' at 532.62 (see also later section), and in the Alphabetical and Facet.

The failure was also due to searching in that the searcher also ignored the concept of bubble in all systems.

(123) 20-15. A document on the design of turboprop transport aircraft was indexed under 629.138.5.001.1 Design. Transport aircraft, but the concept 'Transport aircraft' was omitted from Alphabetical, Facet and Uniterm.

In Alphabetical, if an entry had been made under AEROPLANES, TRANSPORT, the document would have been traced.

(124) 31-14. A document on an electrolytic tank as an analogue computing machine for factorizing high degree polynomials, failed in Alphabetical, because the indexer did not include EQUATIONS, POLYNOMIAL in Alphabetical. A different searching technique would have traced the document, but this is discussed later.

(125) 32-12. A document on the aerodynamic characteristics of a family of slender wing-tail-body combinations remained untraced in Alphabetical and Uniterm because the indexer omitted to include 'tailplanes', in these systems. As the question asked for material on the drag of tail units behind swept wings around $M = 1$, the searchers naturally insisted upon 'tail units' as a concept for searching.

An entry in Alphabetical reading COMBINATIONS - WING - FUSELAGE - TAILPLANE - Forces and moments, would have enabled the document to be retrieved. Uniterm merely required the additional entry for 'Tailplane'.

- (126) 70-14. A document on the machining and press-forming of panels used in aircraft structures had the concept 'machining' and 'panels' indexed only in U.D.C. and Uniterm. If these concepts had been included in the other two systems, the documents would have been traced. Therefore an entry reading PANELS - Machining, would have been adequate.

In Facet, an entry Ffh Qg Maching: Panels, would have resulted in a successful first search.

- (127) 23-13. A document on similarity rules in transonic flow, remained untraced in Facet, because the searcher would not check through the whole of Mbj Transonic flow, also because the indexer could have included 'Similarity parameters' at Nj.

Therefore an entry Mbj Nj Similarity parameters: Transonic flow, would have enabled the document to be traced, with better searching.

- (128) 31-11. A similar case to (127). If the indexer had included an entry under 'similarity parameters' at Nj plus Nbm Hypersonic flow, the document would have been traced from the question "Hypersonic similarity law for slender bodies". The concept of 'Similarity rules' was included in all other systems.

- (129) 41-11. With a document on the drag of aerofoil sections and thin wings, the indexer ignored this concept entirely in Facet, and concentrated on another aspect of boundary layer in hypersonic flow on flat plates. If an entry under Cd(Iv)Nr Drag: thin: wings, had been made, the document would have been traced.

- (130) 62-13. A document on the deflection and twist of a sweptback wing bomber in rough air, was not traced in Facet, partly because the indexer omitted from this system, the concept of 'gust loads'. Had this been included at Cd(Ilibb)Nq Gust loads: sweptback: wings, the document would have been traced via the question "Spar deflection of a swept wing measured in flight through gusts".

- (131) 24-12. With a document on cavitation flow in pipes, the indexer included the concept 'pressure' in all systems but Uniterm. As the question was on pressure drop of flow in pipes, the searcher did not consider that sufficient Uniterms were retrieved without 'pressure'.

- (132) 38-13. With a document on the welding of titanium sheet, the indexer, through carelessness, did not include either of the concepts, although there were adequate entries in U.D.C. and Alphabetical.

- (133) 41-12. A document on the mechanical design of a gas turbine was not traced in Uniterm because the indexer omitted 'design', although it was included in U.D.C., Alphabetical and Facet.

- (134) 43-14. A document on the tensile and fatigue properties of the Nimonic alloys at high temperatures, failed because the indexer, through carelessness, omitted to include NICKEL ALLOYS and HEAT in Uniterm. As the question asked for information on nickel-chromium based alloys, the searcher

insisted upon this concept.

(135) 45-11. If the indexer in Uniterm had included the concept 'downwash', in a document on the aerodynamics of wings and wing-body combinations, the searcher would have considered the search successful.

Although this concept was also omitted from Facet, the document was traced by the searcher checking in the classified catalogue under Cd Nbk Supersonic flow: Wings.

(136) 46-11. Careless indexing of Uniterm, by the omission of 'Vertical take-off' and 'Aircraft', caused this document not to be found. These concepts had been included in the other systems and as the document was entirely concerned with VTOL Aircraft, the additions should have been made.

(137) 48-12. A document on trajectories of various bodies of revolution remained untraced in Uniterm because the indexer omitted 'trajectories' from his list of Uniterms. As the question was "Stable trajectories for re-entry of high altitude rockets", the searcher felt that this concept was essential.

(138) 50-13. An article entitled "Minimum for problems in vertical and horizontal rocket flight" was indexed in the other three systems under 'Rocket propulsion', or 'thrust of rocket engines'. These concepts were not included in Facet. With more careful indexing, the document would have been traced.

(139) 50-14. A document on shaft gas turbines for helicopters had 'efficiency' or 'performance' included in Alphabetical and Facet. As 'helicopters' was the only Uniterm to be successful from the question "Data on fuel consumption of helicopters in relation to payload", the document was not found.

(f) Lack of entry in indexes to schedules:-

(140) 53-06. In an article on the range of applicability of the transonic area rule, the indexer included 'area rule' as an Alphabetical heading, as Uniterms, and at 533.6.013.122 in U.D.C. As there was no entry in the index to the Facet schedules, under 'area rule', the indexer presumed that there was no place for it, and so entered the article under 'drag' at Nr plus rectangular wings and wing-fuselage combinations, as the nearest possible place.

However, the searcher tried the chain index to Facet, and discovered an entry 'Area rule Oe', and therefore limited his searcher to the cards included there. If there had been an entry in the Alphabetical index to the schedules, or feedback of the index to the semi-completed catalogue, this error would not have arisen.

(141) 47-15. Because of a missing entry in the Alphabetical index to U.D.C., under 'Liquid metals', at 669-154, and another under 'Solidification' at 536.42, the searcher for a question on "Solidification of metals in a cylindrical mold", was unable to go further with the search. If the Alphabetical index had been correct, the search would have been very simple.

(142) 68-11. A document on carbon deposits in combustion chambers of gas turbine engines was indexed accurately at 621.438.019.942, but, as there was no entry to this number in the Alphabetical index to U.D.C., the searcher was unable to find the required place in the U.D.C. catalogue.

(143) 70-13. A new subdivision of 621.45 (Rocket engines) was used in indexing a document on turborocket engines, so one presumes that the number 621.456 was intended as the place for turborocket engines. However, no entry was made in the Alphabetical index to the U.D.C. schedules, and so the document was not traced.

(144) 75-12. A question on the corrosion resistance of aluminium-copper alloys was not traced in U.D.C., and one of the reasons was that there was no entry in the Alphabetical index to the U.D.C. schedules under 'aluminium-copper alloys' at 669.715.3, although that number had been used.

With the correct entry the document would have been traced. Again, in Alphabetical, a new heading was devised under ENGINES, TURBOROCKET. Later, this was included under ENGINES, ROCKET, GAS-TURBINE, but as there was no 'see' reference, the searcher was not directed to the correct place in the catalogue.

(g) Lack of cross references:-

(145) A question which failed in all four systems was "What is meant by a 'moulded harness'". As the searchers had no idea where to start the search except by attempts under 'safety harnesses' the document remained untraced.

Actually, the subject of the document was a new development in the protection of electric wiring for aircraft.

The only possibility of success in any system, other than knowledge of the term, would be to have 'see' references in the index to each system from 'moulded harness, see'.

3. SEARCHING FAILURES

(a) Lack of understanding:-

(146) 40-06. With a question on boundary layer shock wave interaction, the searchers in U.D.C., Alphabetical and Uniterm decided that boundary layer separation would be the result of the interaction, and accordingly included this aspect in their search programme. In each case, the document was traced. The searcher in Facet, however, did not think sufficiently, and checked only the words of the question.

(147) 53-08. With a question on the measurement of heat transfer between concentric cylinders the searchers in U.D.C. and Facet failed to trace the document because they did not connect the question with the problem of flow in channels, under which the document is indexed.

The searcher in Alphabetical thought of this aspect, whilst in Uniterm, 'parallel plates' was brought out, and so constituted a success. (See also (152)).

(148) 54-07. With a question on the fatigue strength of Redux bonded 10 SWG aluminium alloy sheets, the first consideration was that the question was rather misleading, as the document was actually about fatigue tests on joints. However, on second thought the inclusion of 'bonded' in the question should infer that some form of join was caused to the aluminium alloy sheeting. Hence 'joints' would be a logical place to search. In the Alphabetical catalogue, the searcher did not try this aspect, nor did the searcher in Facet. Had this aspect been chosen in the first search programme for each system, the document would have been traced immediately.

(149) 60-07. With a question on the transient response of ladder networks, the searcher in Facet tried only 'transient' and 'response' in the chain index. He did not think of checking under circuits, as there is no place for networks in Facet. In Uniterm, the searcher did not think of circuits, either.

(150) 67-09. With a question on thermal stresses in a body exhibiting temperature dependent elastic properties, the searcher in Alphabetical tried all combinations of the words used in the question, but did not try 'Thermoelasticity', which should have been the next logical step. Had this been done, the document would have been traced.

In U.D.C., there is no place for thermoelasticity, and so 'thermal stresses' at 536.495 plus 'Elasticity' at 539.377 was used. However, as neither of these concepts were brought to the head of the entry, the document remained untraced.

(151) 77-06. The question on the performance of engines with liquid injection was misunderstood by three of the searchers. They took the 'liquid injection' to refer to fuel injection, when, in actual fact, it referred to water injection.

A fourth searcher, in U.D.C., found the document from his first search programme, under 621.438.057.3 (Water injection systems. Gas turbine engines).

(152) 77-10. The question on the mean temperature in a cylindrical tube due to heat transfer by laminar flow, the searcher in Alphabetical, as with question 53-08, failed to relate this problem to flow in channels, under which the document was indexed.

(153) 79-06. With a question on the effect of Reynolds number on measurements of pitching moments at transonic speeds, the searches in U.D.C., Alphabetical and Uniterm were failures because the searchers did not take the next logical step from 'pitching moments', to 'longitudinal stability'. In Facet, the searcher did think of this aspect, and so traced the document.

(154) 30-12. The searchers when presented with a question "What is meant by a 'moulded harness'" had no idea of where to start the search. Perhaps a searcher with electrical engineering knowledge may have been able to associate the question with a new development in electrical wiring.

(155) 31-15. A question on impact loads on hydro-skis on aircraft failed partly because the searchers limited their search programmes to headings and numbers containing 'hydroskis'. (For another reason, i.e. had choice of heading in Alphabetical, see 4d).

If the searchers had considered the connection between impact loads and landing, the document could have been traced in U.D.C., Facet and Uniterm. In Alphabetical 'landing' would be hidden on a subheading, and so would have been useless as a searching concept.

(156) 36-14. The searchers in all systems did not think of checking under 'deflection', from the question "Bending of anisotropic plates", when the concept 'bending' did not trace the document. Instead, the searchers tried 'buckling' and 'stresses'.

Had this concept been included in searches in all systems, the document would have been traced.

(157) 38-14. A question "Means by which the pilot of a military aircraft may achieve the maximum possible time in combat from his aircraft", had an unimaginative search programmes. Although the question was rather ambiguous (1d), the searchers should have thought through the question to the concept 'range'. Had this been done, the document would have been found in all systems.

(158) 65-13. A question on Reynolds stresses in two-dimensional parallel boundary layer failed in Alphabetical, because the indexer accepted the term 'parallel boundary layer' and did not think of looking under 'parallel flow'. The concept 'parallel' if used in all four searchers, would have enabled the document to be traced (except in U.D.C., where there is no place for 'parallel flow').

(b) Failure to use all the concepts given in the question:-

(159) 26-08. With the question on the comparison of heat transfer theories *in forced non-isothermal convection over arbitrary surfaces, the searcher failed to use any concepts - in fact, he did not attempt a search programme because of the generality of the question, and the number of entries in the chain index he would have needed to check to find the document.*

As it happens, if he had checked under 'forced convection' in the chain index, he would have found eighteen entries, amongst them the document he was searching for.

(160) 41-09. As in question 26-08, the searcher refused to search for this document, because he said that there were too many entries under 'heat transfer' to attempt a search. In this he was wrong. The question asked for material on heat transfer coefficients and temperature recovery factors at Mach numbers of 1.62. If he had assessed this question carefully, he could have obtained three concepts: Measurements (which he would not have checked), Heat transfer: Supersonic flow. On checking the chain index directly under these two concepts, fifteen cards were traced, with the required entry second. Admittedly, for a full search, the searcher would have needed to check all cards under 'heat transfer' that contained 'supersonic flow', on the card, but the first checking in the chain index would have been a reasonable attempt.

(161) 46-07. With a question on pressure distribution on elliptic cones at supersonic velocities, the searcher in the Facet system did not use the concept 'elliptic'. If he had done so, the document would have been traced. In the search programmes for the Alphabetical and Uniterm systems, the concept was used. In U.D.C., the search tried 'Elliptic wings' at 533.696.5, and there is no place for elliptic sections in general.

(162) 56-07. The searcher checking the U.D.C. catalogue for a question on the value of model testing for predicting instability of structural elements, tried only 530.17 Analogies. He did not try any part of the aspects 'structural elements'. As the indexer indexed the document under 621-415 Sheets, it is doubtful whether the searcher would have checked through the types of structures to find this.

(163) 57-07. With a question on the performance of perforated supersonic diffusers, the searcher in the U.D.C. catalogue did not, in any of his search programmes, check the concept 'perforated'. If he had done so, with the number for diffusers 533.697.3 (already chosen in his first search programme) the

document would have been traced. In the other three search programmes, this concept was included, and helped to trace the document.

(164) 64-07. When searching for the required document in the U.D.C. catalogue, from the question "Would deflecting the jet exhaust from a turbine engine permit increases in lift with double slotted flap wing of order of magnitude of thrust", the searcher did not use the concept 'slotted flaps'. If she had done, the document would have been traced at 533.694.22 (Slotted flaps).

(165) 66-08. From the question on the aerodynamic centre of two-dimensional aerofoils at transonic speeds, the searcher in Alphabetical did not check the concept 'CENTRE, AERODYNAMIC'. If he had done so, the document would have been traced.

(166) 68-08. The searcher checking the Alphabetical catalogue to trace a document from the question "Applications of Mellin transforms to plate theory" tried only 'Plate theory'. A logical step would have been to check under 'Plates', where the document would have been found.

(167) 73-09. With a question on the reduction of kinetic heating from the structural standpoint to fundamental principles the searcher in Facet refused to search because he said there were too many entries under 'aerodynamic heating' in the chain index. Had he taken the concept 'structures' and from that tried C 'Aircraft structures' and Fa 'Structures', plus Oi 'Aerodynamic heating', the search would have been narrowed considerably, and would have become possible. In fact, if the searcher had tried the classified catalogue at C Oi, the document would have been traced.

(168) 75-08. With a question on the rate of shrinkage of plastics at high temperature, the searcher in the Alphabetical system ignored the concept of 'high temperature'. If he had indexed it in his search programme as 'temperature effect', the document would have been traced. The searchers in U.D.C. and Uniterm, who found the document, had included this concept in their programmes.

(c) Chain index:- (refers to Facet only)

(169) 20-08. In a question on panel flutter analysis, the searcher, after checking Ffh (Panels), On (Flutter) in the classified catalogue, decided that there were too many places to check in the chain index, and so gave up the search.

If the searcher had continued, and checked the many cards, the document would have been traced under either (1) Ffh(Is)(Zvk)On Ya or (2) Ffh(Is)(Zvk) Nbk On Ya.

(170) 29-07. With a question on the alleviation of pitch-up by the use of leading edge slats, the searcher checked Ct Ieb Nub (Pitching moments: Leading edge: Slats) in the classified catalogue, and then checked in the chain index under Nub Pitching moments + Ieb + Ct and found no entries. He then tried in the chain index for Nub plus Ieb Leading edges or Cd wings - and found fifty-seven cards to be checked. The document was actually under Ca Cd(Iibb)Ct Ea Ieb Nbj Ob Vn - Wind tunnel tests: stability: transonic flow: leading edges: fuselages: slats: sweptback: wings: combination. Therefore, it would only have been found if the searcher, instead of switching from Ct to Cd, had dropped an element from the first search and concentrated on all cards containing Ct and Ieb.

(171) 30-08. A question on unsteady laminar boundary layer flows proved too general for the chain index. The searcher checked in the classified section under Ncd Nci Nfk (Boundary layer: unsteady flow: laminar flow), and then checked in the chain index under Ncd where he found seventy-five cards. The search was then dropped.

The document was indexed at Ffe(Is)Ncd Nfk Ya. (Calculation: boundary layer: laminar flow: flat plates) - so, if the searcher had dropped the middle element, the document would have been traced eventually.

(172) 31-08. With a question on the effect of shock waves on laminar boundary layers, again as in the question above, this is a very general question (for such an aerodynamic collection) to be answered via the chain index.

The first programme consisted of the concepts Ncd, Nfk, Nhd - (Shock waves: boundary layer: laminar flow). After checking in the classified catalogue under these elements, the searcher tried the chain index under 'shock waves', plus the other two elements, and found eight places, with no trace of the required document.

As the following search programmes would have meant looking in the chain index under the sub-division of Nhd (Shock waves):-

Nhf - Normal shock waves
Nhh - Oblique shock waves
Nhj - Attached shock waves
Nhk - Detached shock waves

- each in turn with the other d elements required (Ncd and Nfk), the searcher did not proceed any further with the search.

The document would have been found under either:-

- (1) Ffe(Is)Nbk Ncd Nfk Nhh Nvf Oe -
Wind tunnel tests: interactions: pressure
distribution: oblique shock waves: boundary
layer: laminar flow: supersonic flow:
flat plates.
- (2) Ffe(Is)Nbk Ncd Nfk Nhh Ni(2F)Oe Vn -
Wind tunnel tests: distribution: velocity:
oblique shock waves: boundary layer:
laminar flow: supersonic flow: flat plates.

(173) 41-09. With a question on heat transfer coefficients and temperature recovery factors at Mach number of 1.62, the searcher refused to conduct a search because of the number of cards under heat transfer. In fact, the failure was due to the searcher giving some of the concepts given in the question.

If the searcher had checked under all cards under heat transfer, the document would have been traced at:-

Hrj(Ips)Nbk St Xz - Measurement: heat transfer:
supersonic flow: annular nozzles.

(174) 50-06. With the question "Use of potential analyser to give loadings on thin wings", the searcher failed to trace the document because he tried Npb (Aerodynamic loads) in the chain index together with Cd Wings, but when this was not successful, he felt that to check under each type of loading separately would be too long. (There are twenty-eight subdivisions which would have meant

215 entries into the chain index).

The document would have been found under either:-

- (1) Cd(Ikb)Nvf Oqb Oqt 6 - Aspect ratio 6:
angle of attack: pressure distribution:
rectangular: wings.
- (2) Cd(Ij)Nvf Oqb Oqt 4 - Aspect ratio 4: angle
of attack: pressure distribution: delta wings.
- (3) Cd(Iibb 45)Nvf Oqb Oqt 3. - Aspect ratio:3:
angle of attack: pressure distribution:
sweptback 45: wings.

The searcher would have reached Nvf (Pressure distribution) at the twenty-second search, if he had worked down the schedules.

This question shows particularly clearly how specific one has to be when compiling search programmes for the chain index; unless one is willing to look under the entire general section, in this case Cd (Wings). Yet, if this happened, the searcher would not be sure that everything under 'wings' had been checked - he would also have to check 'Wings', in the chain index and try all entries under that heading.

In Alphabetical, the document was traced by checking the whole section under WINGS, LOW DRAG, and in U.D.C., by using the inversion of 533.693: 533.69.048 +.

(175) 56-07. With a question on the value of model testing for predicting instability of structural elements, the searcher did not attempt a search, or formulate a search programme, as she said that the question was far too general for Facet. The aspect 'structural elements' could be under any section of Fa (Structures). Under this heading are thirty-eight types of structural parts, elements, or type of structure.

If she had persevered, and formulated a search programme, the document would have been traced at Ffh Peal-a Rqg Vi - Tests: compression: aluminium alloys: panels.

(176) 57-08. With a question on the flexive-torsion flutter characteristics of aerofoils, the searcher tried Onb Flexive-torsion flutter + Cc Aerofoils with no success. She then tried On Flutter + Cc Aerofoils, but decided that there were far too many cards under 'Flutter' which included aerofoils, or wings to conduct a realistic search.

The document would have been traced at Cd(Ikb)On Sfu - Damping: flutter: rectangular: wings.

(177) 65-06. With a question asking for information on structural stresses at which plastic flow occurs, the searcher was only able to obtain two concepts, one 'plasticity' and the other 'stresses'. He checked under 'Stresses' in the chain index, and found thirteen entries where both 'Stresses' and 'Plasticity' occurred. The document was not found here, so Rip Plasticity was checked. At this number fifty-six cards were found, and so the search was abandoned. If it had been continued, the document would have been found under either:-

- (1) Rgz Rip Ya - Calculation: Plasticity:
deformations.
- (2) Ffe(Is)Rip Rmt Ya - Calculation: thermal
stresses: plasticity: flat: plates.

- (3) Ffn Rip Rmt Ya - Calculation: thermal stresses: plasticity: shells.
- (4) Fqd Rip Rmt Ya - Calculation: thermal stresses: plasticity: discs.
- (5) Fq Rip Rmt Ya - Calculation: thermal stresses: plasticity: cylinders.

In this case, the subdivision of 'Stresses' at Rm into seven, caused a failure. 'Thermal stresses' would have been seventh on the list if the searcher had worked down the schedules.

(178) 68-10. With a question on the fundamental mechanism of the growth of turbulence in the boundary layer, the searcher failed to find the required document in Facet, because of the number of cards he met when checking the chain index under boundary layer and turbulence. Fifty-three possible places were traced.

As it happened the document was not indexed under turbulence, therefore the search would have been further prolonged. It was actually indexed under: Nbk Nfk Nfn Rv - Roughness: transition: boundary layer: supersonic flow.

(179) 71-06. The searcher looking for a document from the question "Jet deflection by auxiliary air injection", after trying Gsg (Jet deflection) and Cs (Jet flaps) in the chain index, checked under Ngx (Jets). Here, he found far too many cards to constitute a realistic search.

If he had continued, the document would have been traced at Gf Gs Hrij(Zd)Ngx - Jets: variation: nozzles: exhaust systems: gas turbine engines.

(180) 76-06. Another example of the difficulty of searching for a general question in the chain index occurs with 'Manufacture of wind tunnel models'. As there is no indication in the question as to what type of model is referred to (there being no general section for 'models', only the adjectival form), the number of places to check proved too much for the searcher.

The document would have been traced under Bc(Zs)Qg - Machining: model: aeroplanes.

(d) Failure to search systematically:-

(181) 25-09. With a question on the allowable humidity in intermittent wind tunnels, the searcher, amongst other combinations, tried 533.6.071.54 - the number for humidity of wind tunnels, with no success. The next logical step would be to check 533.6.071. As the indexers did not use the sub-divisions of this number by type of wind tunnel, all types were classed at 533.6.071. If the searcher had checked here, the document would have been traced at 533.6.071: 533.6.011.5.

(182) 33-09. From a question on the variance of the shock standoff distance with the strength of a magnetic field, the searcher in Facet tried Nhd Shock waves with Sjn Magnetohydrodynamics, as his first search programme. If he had searched systematically, he would then have tried the sub-section of shock waves, e.g. normal, oblique, attached and detached, plus magnetohydrodynamics. The document would have been traced at Fp Fu Nbm Nhk Sjn - Magnetohydrodynamics: detached shock waves: hypersonic flow: blunt bodies: bodies of revolution.

(183) 27-08. With a question on throttle fuel controls for gas turbine engines, the searcher in Facet compiled a search programme of Gf - Gas turbine engines, Gn - Fuel systems and Vfc - Controls. When this proved unsuccessful, he dropped Gn, Fuel systems. In my opinion, he should have kept Gn, and checked in the chain index for everything he could trace on that.

The document would have been traced at Gn Vi - Tests: fuel systems.

(184) 39-06. With a question on the use of thrust reversal in reducing the air speed of a jet transport in flight, the searcher in Facet tried Bhg (Turbojet aeroplanes) in the classified section, but did not check in the chain index. If he had done so, the document would have been traced under B(Abb)Bhg Vff - Stopping: turbojet aeroplanes: passenger carrying: aircraft.

In Alphabetical, the searcher tried AEROPLANES, JET, but did not go through the types of aircraft, subdivided by the adjective 'jet'. If he had done so, the document would have been found.

(185) 64-06. The searcher of the Alphabetical catalogue to trace the required document for the question "Effect of aspect ratio on the lateral stability of swept (30-60) wings", made twelve attempts, yet in my opinion, did not make a systematic search. He tried many subheadings under WINGS, SWEPTBACK (35) and WINGS, SWEPTBACK (+ speeds), but did not go to the whole section of WINGS, SWEPTBACK (30-60). In such a question, where the degree of sweptback covers such a large range, to pick out one degree (35) and ignore the rest, is to make an illogical search.

The document would have been traced under:

WINGS, SWEPTBACK (45) - Stability

WINGS, SWEPTBACK (45) - Aspect ratio

(186) 64-07. The question "Would deflecting the jet exhaust from a turbine engine permit increases in lift with double slotted flap wings or order of magnitude of thrust", prompted the searcher in Facet to check under (1) Cd Crf - Slotted flaps: wings, and (2) Crf - Slotted flaps, in the classified catalogue. However, instead of checking the chain index under these elements, the searcher changed them in her next search programme.

Had she been consistent, and checked under Crf in the chain index, plus Cd, the document would have been traced under Cd(lkb)Crf Ngx Nq Nrb Okd Vn - Wind tunnel tests: blowing: pitching moments: lift: jets: slotted flaps: rectangular wings, at the first attempt.

(e) Incorrect searching:-

(187) 24-09. With a question on the calculation of damping in roll at supersonic speeds, the searcher in the Facet catalogue chose to express 'roll' in the notation under Aerobatics Kp, which is obviously the wrong place. He should have checked Nud Rolling moments, which more expresses the aerodynamic aspect. If he had checked Nud Rolling moments and Nbk Supersonic flow, the document would have been traced, that is, if he had made this one of his search programmes. In actual fact, he included 'Rolling', 'Supersonic flow' and 'Damping' in his first search programme, but in his second and third, he insisted on 'Damping' and other elements.

(188) 29-07. In a question on the advantages and uses of leading edge slats, the searcher in U.D.C. checked 533.694.25 Leading edge flaps, instead of 533.694.26 Leading edge slats. If the searcher had been correct, the document would have been traced.

(189) 55-08. Although a question was on the formulae for calculating the effect of local modification in structural matrices, the searcher in U.D.C. insisted on checking aircraft structures at 629.13.012, instead of the more obvious place, 624.072.2. If this number had been checked, the document would have been traced without difficulty.

(190) 71-08. With a question on the weight of cabin pressurisation equipment, the searcher in Alphabetical looked under CABINS, PRESSURISED, and PRESSURISATION. Had he looked under CABINS, Pressurisation, the document would have been traced. As the article is about the pressurisation of cabins, rather than information on pressurised cabins as such, the proposed search programme appears the more logical.

(191) 39-14. A question on "Ignition qualities of aluminium borohydride" remained untraced in U.D.C., Alphabetical and Facet, because the searchers thought that aluminium borohydride is a solid fuel, whereas it is actually a liquid fuel. If the searchers had checked in the catalogue under liquid fuel, the document would have been traced.

In Uniterm, the document was traced because 'combustion: ignition: propellants' were successful Uniterms.

(f) Insufficient searching:-

(192) 26-06. With a question on hydrogen in metals, the searcher in Uniterm tried Metals: Hydrogen: Molecules: Alloys and Atoms. Hydrogen was the only Uniterm to be traced. The searcher should then have tried 'Steels', because she knew that there is much written on the effects of hydrogen in steels, and 'Embrittlement', as one of the effects of hydrogen is to cause embrittlement.

In the Alphabetical search, the searcher also failed to check under 'Steels', where the article was indexed, with the subheading 'Embrittlement'.

(193) 31-06. With a question on the photoelastic investigation of stress concentration, the searcher in the Alphabetical system tried only PHOTO-ELASTICITY and STRESS DISTRIBUTION. He ignored the possibility of the entry being under STRESSES - Photoelastic tests, where in fact, it had been indexed.

(194) 35-10. With a question on the calculation of heat flow in a cylinder surrounded by a radiation shield, the searcher in Facet in his first search required Stg (Conduction) with Fq (Cylinders), and when this was unsuccessful, he checked Radiation. As 'Conduction' was not specifically mentioned in the question, I think that the search could logically have tried 'heat transfer' and 'temperature' before going on to the aspect of radiation.

The document would have been traced at Fq Ilf(Ipc)Ssb Ya. (Calculation: temperature: circular: cross-section: cylinders). Better indexing would have had an added entry with 'heat transfer' instead of 'temperature'.

(195) 36-10. The searcher in the Alphabetical system failed to trace the required document from the question "Measurement of surface pressure on thin bodies", although she formulated five search programmes.

If she had considered looking under 'pressure distribution' the document would have been traced at the fifth attempt.

(196) 51-06. With a question on the structural influence coefficients for thin low aspect ratio wings, the searcher in the Alphabetical catalogue tried 'aspect ratio' as a subheading with many types of wing, but did not check the same concept as a main heading. If he had done so, the document would have been traced.

(197) 56-08. With the question "Supersonic flow over a step", the searchers should, with thought, have realised that 'Wedge' was a possible entry. This applied to U.D.C., Alphabetical, Facet and Uniterm, where there were places for the concept. However, the principal cause of the total failure is due to indexing.

(198) 57-08. The searcher in the Alphabetical system for this question, on flexure-torsion flutter characteristics of aerofoils, tried 'Aerofoils' and 'Aerofoil sections' in her four search programmes, but did not try 'Wings'. The terms 'Wings' and 'Aerofoils' were used rather loosely in the papers, and hence the indexers themselves tended to do the same.

In this particular instance, the entry was under WINGS, OSCILLATING - Damping. It would probably have taken several search programmes to eventually trace this via WINGS - Flutter, etc. Also, the term 'WINGS, OSCILLATING', tended to be overlooked by the searcher. It was used in indexing quite frequently, but there appears to be such a fine difference between WINGS, OSCILLATING and WINGS - Flutter, that if the term 'flutter' is used in the question the searcher tends to look under the subheading rather than the compound term.

(199) 57-09. With the question "Influence of human engineering factors in forecasting of load spectrum of aeroplanes", the searcher in Alphabetical and Uniterm failed to check all possible places.

In Alphabetical, the searcher compiled only two programmes, one 'HUMAN ENGINEERING', and the other 'AEROPLANES - Loads'. If the searcher had thought one step further, under 'STRUCTURES, AIRCRAFT - Loads', the document would have been traced.

In Uniterm, the searcher could have checked 'spectrum', which was actually mentioned in the title, also 'calculation' is a logical Uniterm to express the concept 'forecasting'. Had this happened, the successful Uniterms would have been 'Loads', 'Aircraft', 'Spectrum' and 'Calculation' - sufficient to warrant a success.

(200) 71-06. The searcher in U.D.C., with the question "Jet deflection by auxiliary air injection" formulated two search programmes - the first 532.525.2 (Jets - hydrodynamics) and 621.438.067.6 (Exhaust devices, gas turbines) but did not check 533.697.4 (Jets - Internal aerodynamics). If he had done so, the document would have been traced at the first attempt.

(201) 72-08. With a question on the design of blow-down wind tunnels, the searcher in the Alphabetical system tried WIND TUNNELS, BLOWDOWN and WIND TUNNELS (subdivided by speed of flow). However, he did not try

WIND TUNNELS, INTERMITTENT, which he should have done, knowing that a 'blowdown wind tunnel' is a type of 'intermittent wind tunnel'. The document would have been found under WIND TUNNELS, INTERMITTENT, SUPERSONIC - Flow problems.

(202) 75-08. The searcher in the Facet catalogue, from the question "Rate of shrinkage of phenolic-mineral moulding compound at 125 'C' ", tried only 'phenolic resins' and 'phenolic plastics', at Phyb and Pia respectively. He did not try 'plastics' at Ph. If he had done so, the document would have been traced at Ph Rab Ssb(Zqn)(Zb) Stability: high; temperature: dimensions: plastics.

(203) 34-12. A question "Design information on wind tunnel corner 90° bend with turning vanes", remained untraced in all systems. The document actually referred to wind tunnel diffusers. In none of the searching programmes was the concept 'diffuser' thought of. This should have been checked and would have caused a successful result, except in U.D.C., and Alphabetical, where the indexer placed the document under DIFFUSERS, instead of DIFFUSERS, WIND TUNNEL.

(204) 21-12. A document which was not traced in Alphabetical or Facet, could have been found if the indexer had included the concept of 'wedges' - though with the question on wave drag at zero lift of two body arrangements consisting of two surfaces of delta planform, it is doubtful whether the searcher would have considered 'wedges' a suitable concept for searching. As the subject of the document is so difficult to express, the term 'wedges' appears to be the only way the document could have been traced.

4. SYSTEM

(a) Number of places for the same subject:-

(205) 29-08. From the article entitled "Beam strength and curvature under combined tension and bending in the plastic range", the question was phrased thus "Effect of combined tension and bending on curvature of beam in the plastic range". In both indexing and searching, difficulty was found because of the concept 'bending'. In U.D.C. there are the following entries in the Alphabetical index:-

- | | | |
|----|--------------|--|
| 1. | 539.384 | Bending. Deformations. Physics. |
| 2. | 621.772.31 | Bending, pipe. Workshop practice. |
| 3. | 621.774.63 | Bending, tube. Workshop practice. |
| 4. | 539.413 | Bending strength. Resistance to stress. Physics. |
| 5. | 620.174 | Bending strength tests. Materials testing. |
| 6. | 620.174.251. | |
| | 224 | Bending strength tests. High temperature. Materials testing. |
| 7. | 531.224 | Bending stresses. Resolution of forces. Mechanics. |
| 8. | 620.178.74 | Bending tests, impact. Materials testing. |

Of those, 2 and 3 - Workshop practice can be eliminated for this particular document and question, and numbers 5, 6 and 8 on Bending strength tests can be placed on one side for later search programmes if required, but numbers 1, 4 and 7 are all from the Physics section, under 'deformation', 'resistance of stress' or 'resolution of forces'. It is sometimes extremely difficult when indexing to decide into which of the last two sections a particular aspect should be placed.

From the above question there is little indication which place should be searched.

In Alphabetical, 'Bending' is used as a main heading, and as a subheading. 'Bending stresses', as the heading and subheading 'Stresses, bending', are also permitted, but there is not much difficulty caused by this, as by the U.D.C. schedules.

(206) 72-08. The search programme for this question, on the design of blowdown wind tunnels, points out two possible headings in the Alphabetical catalogue, WIND TUNNELS, BLOWDOWN, and WIND TUNNELS, INTERMITTENT. As a blowdown tunnel is a type of intermittent tunnel it would be better either to include them both under the more general heading, or to have a 'see also' reference from one to the other.

In this particular document, the title as "On the choice of working fluid for intermittent supersonic wind tunnels", and the question referred to 'Design of blowdown wind tunnels'. Hence, the indexer used the heading WIND TUNNELS, INTERMITTENT, and the searcher, WIND TUNNELS, BLOWDOWN.

(207) 49-06. From a question on starting flow characteristics in feed systems of liquid propellant rocket motors, the number of possible places which can include types of rocket engines are discovered.

Under Gj Rocket engines, one finds subdivisions Gjb Liquid propellant rocket engines, and Gjd Solid propellant rocket engines.

It is also possible to describe liquid propellant rocket engines by :

(a) Gj Pck(Pre) Liquid: propellant: rocket engines, and solid propellant rocket engines by: (b) Gj Pck(Prb) Solid: propellant: rocket engines. Finally, one can also classify by type of fuel, e.g. (a) Gj Pce Liquid fuels: rocket engines, and (b) Gj Pcg Solid fuels: rocket engines.

Although, when one is used to the indexing system, it is quite apparent that Gjb and Gjd are the most useful places, a person who is unused to indexing or searching could, quite legitimately, make entries under either of the other two methods.

(208) 49-07. Again, the question on conical flow at supersonic speeds over non-symmetric bodies, brings out two places in Facet, under which the aspect 'conical flow' may be placed. One can either use the adjective 'conical'(Igr) with 'flow' (Nbf), hence reading Nbf(Igr) Conical: flow; or one can use speed of flow or Nbh Subsonic, Nbj Transonic, Nbk Supersonic or Nbm hypersonic, together with Fr Cones, hence reading: Fr Nbk Supersonic flow: cones.

In this particular question, the indexer indexed the document under Fr Nbk Nvf Pressure distribution: supersonic flow: cones, whilst the searcher checked only 'conical' (Igr) in the chain index.

(209) 52-15. A question "Description of an optical method of measuring surface finish in which the sample is notated" threw up the problem in U.D.C. of the number of possible places for measurement of surface defects. From the Alphabetical index, the following entries are seen :-

620.191	Surface defects. Materials defects
621.795	Surface finishing, mechanical
620.179.6	Surface tests
539.211	Surface texture. Physics

Under 'Measurement', the searcher found:

53.082.5	Optical phenomena.Principles of measurement
531.74	Measurement of geometrical magnitudes.

The combination of these six places deterred the searcher, who was not able to trace the document although it was at 620.191:531.715.

- (210) 36-15. The question on the descent of winged orbital vehicles was found in U.D.C. and Facet because 'Satellites' is the obvious place (and only suitable place) in which to index and search. In Alphabetical there are the following headings:

SATELLITES, ARTIFICIAL
SPACE VEHICLES

A 'see also' reference may have helped in this particular case, but the material is split up under two headings. In some cases, it is obvious which one to choose, but in others, less obvious.

- (211) 36-13. A question "A shell theory for cylinders" showed that in the Facet catalogue, material on hollow cylindrical shells, or cylinders, is divided between

Fq(Iyh) Hollow: cylinders
Ffm(Igq) Cylindrical: shells

Some decision should be made as to which is the more suitable, and material placed under one heading, with a 'see' reference in the chain index from one to the other.

(b) Lack of places in the schedules:-

- (212) 72-08. Although this failure has been blamed in part to lack of place for 'blowdown' wind tunnels in the U.D.C. schedules and one must state that there actually is provision in the printed schedules, for subdivision of types of wind tunnel by Alphabetical order under WIND TUNNELS (TYPE). The indexers in the project decided early in the indexing programme that this subdivision would not be used.

Thus, the question 'design of blowdown wind tunnels' did not trace the correct document because the indexer would not make an entry simply under 533.6.011, presumably because he thought this number too general, but used 533.6.071.46 - Humidity of wind tunnels. Although this is referred to in the text, the question gives no indication of this aspect.

- (213) 72-09. From a question on the description of plant for testing aircraft equipment and components under simulated high altitude conditions, it has been found that there is really no adequate place for 'testing plant' in U.D.C., Alphabetical or Facet. In U.D.C., the most suitable number is 533.6.07 (Ground testing techniques). In Alphabetical, the heading TESTING EQUIPMENT is not adequate, as one wishes to emphasise the aspect of the plant used for testing - which counts more than the aspect of 'equipment'.

In Facet, the only place provided in the schedules is Ez 'Model-testing equipment', which is quite unsuitable.

- (214) 76-06. With an article on the manufacture of supersonic wind tunnel models, the indexer found difficulty in placing the aspect 'wind tunnel models'. There is no place in Facet to be used generally for models, but one can use Zs (Models), as an adjective to be attached to the substantive. In this particular case, the use of the adjective is quite unsatisfactory, as the article covered the manufacture of several types of model, and so should have been placed at a general heading.

(215) 31-13. A document on laminar boundary layers at the surface of co-current parallel streams was untraced in U.D.C., and the failure can be partly considered to be due to lack of place in the U.D.C. schedules for the aspect 'parallel flow'.

As the question was "The hydrodynamics of fluid-fluid interaction at the interface of parallel streams", the searcher had few concepts to try. In Facet, the search was attempted via 'parallel' in the chain index, plus boundary layer. In Uniterm, the successful concepts were 'parallel: flows: boundary: laminar'. The question also failed in Alphabetical.

The document was indexed only under 532.526.2 Laminar boundary layer, which the searcher considered too general.

(216) 36-11. A document on the estimation of wave drag of forebodies and afterbodies with conical and parabolic shapes, had the question "Supersonic drag of a parabolic nose cone".

In U.D.C., there is no place for 'parabolic' shapes'. Hence the searcher was able only to check under 'cones', etc. with 'drag'. With inversion, it was not possible to trace the document, as 533.6.013.129 'wave drag' had been used.

The same applies for the Alphabetical system, as no heading had been made under parabolic shapes.

(217) 73-12. There is no place in the present list of Alphabetical headings for 'linear systems'. A question "Calculation of natural frequency of damped vibration of a linear system", failed because of the lack of heading. The searcher checked under VIBRATIONS, FREQUENCY and RESONANCE.

The document was actually indexed under SERVOMECHANISMS - Calculation, plus three other headings not applicable to the present question.

The same restriction applies also in Facet.

(218) 35-14. In Facet, there is no place generally for 'performance', which can be applied to engines, etc. The only place is at Ja under Aerodynamics and this is hardly suitable.

A question "How to determine the value of the turbojet engine time constant from experimental data", was not traced, partly because of the inability of the searcher to try the concept 'performance'.

(219) 76-11. A document on the response time of transducers with negative voltage feedback was not traced in Facet because no place was provided for 'transducers'. The indexer used 'amplifiers' which is not satisfactory.

As transducers had been placed in the Zz schedules, it would have been better to have used this place.

(c) Lack of subdivision, causing the placing to be too general:-

(220) 25-09. In this particular example, the criticism is of the U.D.C. schedules used by the indexers, and not of the printed schedules.

With an article on intermittent wind tunnels, the only place in which to place this concept is at 533.6.071, as the indexers did not use the subdivision by alphabet provided for in the printed schedules.

(221) 26-07. The indexer dealing with the article on reciprocity relations in aerodynamics, was unable to adequately index 'reversed flow' as there is no place provided in the schedules. As the flow in this case is supersonic, he was able only to make an entry at 533.6.011.5 'Supersonic flow'.

(222) 26-12. A document on annular flow between concentric cylinders was not traced in U.D.C. One of the reasons for failure, was that there is no subdivision under 'cylinders' into types of cylinder. Alternatively, it can be said that a place under material shapes at 621-4 ... schedules for 'concentric', would have sufficed.

As it was, the searcher was not able to trace the document under 'Annular flow: cylinders', and decided that to check under 'cylinders' generally would be too general a search.

In the other systems, there is ability to include 'concentric' and so the document was traced in all but U.D.C.

(d) Bad choice of heading:-

(223) 31-15. A heading used in Alphabetical of AEROPLANES, HYDROSKI, is not the best that could be chosen. A more accurate heading would be FLYING BOATS, HYDROSKI, as any aeroplane with hydroskis, must of necessity, be a flying boat. In this particular search, from the question "Model experiments related to impact loads on hydro-skis on aircraft", if the searcher had checked under FLYING BOATS, HYDROSKIS, he would have widened his search to include FLYING BOATS, and hence would have traced the document.

(e) Synonyms:-

(224) 20-08. Confusion often arises in the use of 'Plates', 'Panels' and 'Sheets' in technical writing and hence in indexing and searching. For example, in the paper now being discussed, the author used the words 'panels' and 'plates' indiscriminately throughout.

Unfortunately, the indexer has followed his example. In Alphabetical, he uses the heading PLATES, SUPPORTED, and in Facet Ffh Panels. In neither of these systems was the document traced - in Alphabetical because the questioner used 'Panels', and in Facet because of the multiplicity of entries in the chain index under 'Plates'.

In U.D.C., there is no choice - 'Plates', 'Panels', and 'Sheets' go at 621-415 - hence no difficulty in searching. In Uniterm, also a success, because 'Plates' and 'Panels' are considered the same Uniterm. 'Sheets' have a separate entry, which should, I feel, be included with the other two near-synonyms.

(225) 72-06. There is even more confusion in the use of propellants and fuels.

The indexer has indexed under 662.75 in U.D.C., under which both liquid fuels and liquid propellants are placed. In Alphabetical, he has used the heading PROPELLANTS, LIQUID, yet in Facet he has used Pce Liquid fuels. There is provision in Facet for the use of Pck Propellants and (Pce) Liquid, reading: Pck(Pre) Liquid: Propellants.

Therefore, the indexer has been inconsistent in his use of the terms 'Propellants' and 'Fuels'. The failures were principally due to the fact that the article was about 'gaseous' not 'liquid fuels'. The searchers naturally limited their search to this concept.

In Uniterm, the indexer included 'gaseous' thereby causing a success.

Also from the article (39-07) on the design of a miniature solid propellant rocket, there are the following places under which the article can be placed.

U.D.C.	Solid propellants	662-3
	Solid fuels	662-8
Alphabetical	PROPELLANTS, SOLID (but there is a note under Propellants to the effect that only reacting mixtures that do not draw on atmospheric oxygen for combustion should be included here - however, it is often difficult to tell from an article whether this condition applies or not). FUELS, SOLID.	
Facet	Even more confusion here. Pcg = solid fuels, but for someone unused to the system, it is possible to index and check under Pc(Prb) = Solid fuels. Pck = Propellants Pck(Prb) = Solid: propellants.	
Uniterm	'Fuels' and 'Propellants' are under the same Uniterm, therefore, no difficulty.	

It is obvious, from the above two examples, that this confusion between the possible places for propellants and fuels must be cleared up in U.D.C., Alphabetical and Facet. As the two nouns are under the same uniterm, the confusion has not arisen in this system.

(226) 41-12. In the Uniterm system, the terms 'overhaul inspection' and 'maintenance' each have a different number. It would be better to combine them under one, preferably 'maintenance', with references from the other two.

A question on inspection and overhaul of components of a gas turbine, failed because the document had been indexed under 'maintenance'.

(227) 63-11. A question on the downwash characteristics of delta wings in the transonic region was traced in Alphabetical and Uniterm, because the terms 'delta' and 'triangular' are considered synonyms, and one thus included under the one heading. As the document referred to triangular wings, the indexer included this concept in U.D.C. and Facet, but was forced to use 'delta' in Alphabetical and Uniterm.

A combination of these synonyms in the two systems would reduce such errors in future.

(f) Inability to combine particular concepts:-

(228) 31-12. A question on the effect of shock waves on laminar and turbulent boundary layers, failed in the Alphabetical system because of the inability to combine 'Shock waves' and 'Boundary layer'.

The document was indexed under:-

1. BOUNDARY LAYER, LAMINAR
2. BOUNDARY LAYER, TURBULENT
3. SHOCK WAVES

As the sections under each heading were so large, the searcher refused to make such a general search by looking under any of these three.