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A COMPUTER-AIDED METHOD
FOR ANALYSIS OF SNOP-CODED
HISTOPATHOLOGY OBSERVATIONS

Battelle

Pacific Northwest Laboratories
Richland, Washington 99352

MASTER

SEPTEMBER 1974

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OF SNOP-CODED HISTOPATHOLOGY OBSERVATIONS

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A Computer-Aided Method of Analysis
Of SNOP Coded Histopathology Observations

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ABSTRACT

A series of FORTRAN computer programs, running on a CDC-CYBER computer, aid investigators in analysis of histopathology observations of research animals. Clinical and pathologic observations are coded, utilizing the Systematized Nomenclature of Pathology (College of American Pathologists, Chicago, IL, 1965). The first programs sort, uncode, and print them while checking for several types of errors. After the investigator edits these preliminary reports, the second programs print several tables of lesion incidence by treatment group, including a series summarizing neoplastic lesions. Included in this document are instructions for use of the programs, flowcharts, and a microfiche containing detailed FORTRAN code listings.

This paper is based on work supported by the United States Atomic Energy Commission under Contract AT(45-1)-1830.

A COMPUTER-AIDED METHOD OF ANALYSIS OF SNOP CODED HISTOPATHOLOGY OBSERVATIONS

INTRODUCTION

This document describes several computer programs which aid in the analysis of histopathology observations by tabulating the incidence of various lesions in groups of laboratory animals. These programs are based on the Systematized Nomenclature of Pathology (SNOP) dictionary developed by the College of American Pathologists (Chicago, IL, 1965). The pathologist and/or the investigator reduces clinical, gross necropsy, or microscopic observations to a ten-character code defining the anatomical location, the condition observed, and the severity. The computer programs, running on the CYBER-70 computer, operated by Computer Sciences Corp., Richland, Wash., translate SNOP coded observations for proof-reading and editing, then process the data to form several tabular reports. The system is especially useful in studies involving large numbers of animals, or in long-term studies in which the volume of narrative pathology reports is accumulated as each animal dies.

The first sections of this report are oriented to biologists, while the last part presents computer program details. Throughout this report we assume that the reader has access to the SNOP dictionary and we have limited our discussion of SNOP to aspects peculiar to our system. We intend that the computer programs continue to evolve in response to user needs and encourage the reader to suggest modifications or additions which will increase their value.

GOALS OF SYSTEM

The primary goal of the system is to provide an efficient aid in the analysis of histopathology results from research studies involving large numbers of animals. It is expected that investigators with only a few dozen animals per study will continue to tabulate results manually. The computer programs are designed to simplify the tabulation process, not to produce final tables for publication. The investigator must make judgments about which findings are significant and about the degree of condensation of diagnosis terms desirable for a specific study.

A secondary goal is to provide a data base which pools observations of various studies by various investigators which will allow better definition of spontaneous lesions in animal populations. A standard terminology with common definitions is desirable so that inter-study and inter-species comparisons may be made.

A future goal is to routinely tabulate gross findings at necropsy with the microscopic observations. We have designed and tested the SNOP system to handle gross observations. However, these records are not yet routinely collected because we plan to use them in our yet-to-be-completed Tissue inventory system. When this system is operational, we will capture both the tissue identification for inventory purposes and the SNOP code describing why the tissue was sectioned. This will allow a cross-reference between accession numbers assigned by the tissue preparation laboratory and animal identification numbers. It will also add a dimension of quality control in that obvious mis-matches between gross and microscopic SNOP coded diagnoses will encourage re-examination of the tissues in question.

Until these goals are implemented, it will continue to be the investigator's responsibility to confirm that gross and microscopic observations agree as a check on animal number/slide number correlation.

GENERAL DATA SYSTEM

The two Life Sciences Departments, Biology and Ecosystems utilized the Systems Department for guidance in statistical and data processing areas of research projects. A Biometrics Center, staffed by the Systems Department, is located in the Life Sciences Complex. The Center facilitates research by providing consultation about experimental design and statistical techniques and by analyzing experimental results when requested. In addition, the Biometrics Center provides systems analysis and data processing services.

The SNOP system described in this document is primarily a data processing technique. Statistical interpretation of the tabular computer output is a necessary step in drawing meaningful conclusions from experiments. The procedures employed and the form of this interpretation depend on the nature of the research and will vary from experiment to experiment as the investigator and statistician work together.

When a research effort involves a large number of animals it is usually conducted by a multi-disciplinary, multi-department team of investigators. The data analyst is an essential member of this group as shown in Figure 1. Frequent interactions between the analyst and other members of the team helps to avoid costly duplication of data recording and handling through establishment of conventions such as treatment codes to be used throughout the investigation.

FIGURE 1. Overall Data Handling Scheme

The flow of information in a typical study follows this course of events. First, the investigator and statistician establish the experimental protocol, then the animals are given the appropriate treatment and studied for a specified time. At death or sacrifice, the tissues of interest are removed and sectioned. The embedded specimen is stored in the tissue block library, with microscope slides forwarded to the pathologist. Eventually the pathologist's observations are reduced to SNOP codes and forwarded to the data analyst. Preliminary computer printed tables of lesion incidence are returned to the pathologist for review. Final tables are used by the investigator in consultation with the statistician to perform tests of significance on those findings relative to the study.

Both investigators (or their technicians) and pathologists (or medical secretaries) can contribute data recorded on handwritten forms to the Biometrics Center. Forms are checked for completeness, keypunched and accumulated until processing is requested by the investigator or pathologist. Considerable interaction occurs between the researchers and the data analysts to check for errors and edit the data prior to final analysis. This data checking may be postponed until the final report is needed; however, we encourage submitting and "cleaning up" smaller sets of data as they are produced by the pathologist. The Biometrics Center assumes responsibility to store the data for future reference and analyses. As observations become available on control animals tabulations of spontaneous lesions in the animal populations used at the laboratory will be produced.

SNOP CODES

The SNOP code system was developed by medical pathologists, and is not entirely suited for research studies using laboratory animals because of anatomical and procedural differences (e.g., there are no SNOP codes for tail, or euthanasia). However, it is probably the most widely used system, and offers an already published, standardized, logically structured basis for our needs.

The code is well described in the introduction to the SNOP dictionary.

The basic scheme is:

Diseases may be defined in terms of four areas of information: 1) the part of the body affected (Topography); 2) the structural changes produced (Morphology); 3) the etiologic agent (Etiology); and 4) the functional manifestations (Function). This code is divided into four separate, interdependent fields comparable to these areas: Topography, Morphology, Etiology, and Function. Within a field, terms are assigned a four-digit number. The first (left hand) digit indicates the section of the field, the other numbers indicate progressively finer subdivisions. These groupings reflect, as far as possible, natural relations. (page xiv, SNOP dictionary).

We have expanded the SNOP code system by adding two characters: a qualifier code to rank the grade or severity of lesions - 1 (very slight) to 5 (severe); and a code to indicate whether the observation was made while the animal was alive (clinical), at necropsy (gross), or microscopically (micro). We have also allowed space for the observer to qualify his coded observations with remarks.

As we become more experienced with the codes, and as the need arises, we expect to modify the SNOP code dictionary itself by adding codes required by our biology research needs.

One of the difficulties encountered in developing a computer scheme for decoding SNOP codes at a reasonable cost was the multiplicity of definitions and synonyms listed in the SNOP dictionary. We made some rather arbitrary but necessary decisions about this problem. First, we decided that none of the synonyms would be stored in our computerized dictionary; the computer will print the English phrase adjacent to the four-digit code in the SNOP dictionary.

The second decision, possibly harder to live with, concerned the fact that the SNOP code scheme allows for several types of "site-specific" lesions such as bronchopneumonia or appendicitis. The SNOP dictionary indicates that appendicitis should be coded T6600 for the appendix and M4001 for inflammation and that the resulting combination will be translated as appendicitis. Similarly, bronchopneumonia should be coded T2800 for the lung and M4001 for inflammation, with the resulting site-specific combination translating as bronchopneumonia. Unfortunately, it is very expensive for smart computer programmers to instruct the not-so-smart computer to do this. We elected to use the more general code, i.e. M4000, and print such lesion descriptions as "lung, inflammation" or "appendix, inflammation", while fully aware that there are more appropriate descriptive terms. Using the site-specific code M4001 will result in both lesions being described as "appendicitis".

When discrepancy exists between the term printed next to the SNOP code in the dictionary and the term desired by the pathologist, we recommend and encourage entering the desired term in the remarks. That is, if a site-specific lesion is being described, or a synonym is preferred,

or the proper term does not exist in the dictionary, he should select the closest code and enter what he really means in the remarks.

HISTOPATHOLOGY OBSERVATIONS

We have attempted to develop a flexible system to record observations without imposing rigid rules. Although we intend to expand the system to include information obtained at necropsy, our current efforts are concentrated on obtaining the results from the pathologist's examination of slides. Our experience indicates that most pathologists prefer to write or dictate narrative findings about the slides as they examine them. This typed narrative subsequently becomes the basis for the pathologist, medical secretary or investigator to perform the SNOP coding. The slides remain the primary "record" and the narrative and/or codes may be subject to change based on re-examination of the slides.

Clinical findings in the live animal and gross observations at necropsy can also be SNOP coded for tabulation. As with the microscopic findings, these would probably be abstracted from animal records. However, after becoming familiar with the coding, observers may develop a shorthand format for their narrative to facilitate coding. Obviously, recording anatomical location, diagnosis and severity grade, in that order, would save time. A preprinted list of the tissues to be examined would also save time and insure completeness.

CODING, GRADING, REMARKS

The form for recording the SNOP codes is presented in Figure 2. The general procedure for using the SNOP dictionary to code topographic site and diagnosis for each lesion is straightforward. The conventions outlined in Table I insure consistency within and among investigations.

Battelle Pacific Northwest Laboratories	SNOP CODING FORM Systematized Nomenclature of Pathology

(Reserved for Embossed Plate Identification)

Conventions for completing this form:

- I. Type of Observations (circle one)
 C = Clinical
 G = Gross Necropsy
 M = Microscopic
- II. Topographic Code (2 or 4 digit SNOP)
- III. Type of Diagnosis (circle one)
 M = Morphology
 E = Etiology
 F = Function
- IV. Diagnosis Code (4 digit SNOP)
- V. Grade (enter selected number)
 0 = No Grade Assigned
 1 = Very Slight
 2 = Slight
 3 = Moderate
 4 = Marked
 5 = Severe
- VI. Number of similar tumors of the organ.
 (blank will indicate nontumorous)
- VII. Remarks - be concise and specific.

Biology Department Form **H 1**

Histology No. 3 — 8

Experiment No. 9 — 13

Animal No. 14 — 18

Observer's Initials 19 — 21

Date Observed 22 — 27
 mon day year

Optional information:

Treatment Code 73 — 76

Days Post Exposure 77 — 80

	I	II	III	IV	V	VI	VII
	Type Ob- servation	Topography CODE (left justify)	Type Di- agnosis	Diagnosis CODE	Grade	No. Tumors	REMARKS (keypunch may truncate)
	26	29-32	33	34-37	38	39	41-72
1	C G M		M E F				
2	C G M		M E F				
3	C G M		M E F				
4	C G M		M E F				
5	C G M		M E F				
6	C G M		M E F				
7	C G M		M E F				
8	C G M		M E F				
9	C G M		M E F				
10	C G M		M E F				
11	C G M		M E F				
12	C G M		M E F				
13	C G M		M E F				
14	C G M		M E F				
15	C G M		M E F				
16	C G M		M E F				
17	C G M		M E F				
18	C G M		M E F				
19	C G M		M E F				
20	C G M		M E F				

FIGURE 2. SNOP Coding Form

Table I
Conventions For Completing SNOP Coding Form

Histology No.	Important for cross-referencing to slides.
Expt. Identification	Required in connection with animal number to have unique identification.
Animal Identification	Up to five numbers, right adjusted.
Observer's Initials	Pathologist doing narrative or coding.
Date Observed	Date slides read, or, if clinical observation, date animal observed.
Type Observation	C - Clinical G - Gross (Circle appropriate letter) M - Microscopic
Topography Code	Requires either 2- or 4-digit SNOP code.
Type Diagnosis	Circle letter indicating type of diagnosis code entered from SNOP dictionary. M - Morphology E - Etiology F - Function
Diagnosis Code	Required 4-digit SNOP code. If normal observation, usually a M0001 is entered.
Grade	Required for all gross and microscopic diagnosis unless normal or tumor lesions. 0 - No grade 3 - Moderate 1 - Very slight 4 - Marked 2 - Slight 5 - Severe
Number of tumors	Required if tumor lesion (M8000 to M9999) is observed. This indicates the number of discrete tumors or nodules of similar type within the specified organ. "9" indicates multiple tumors such as in a metastatic tumor.
Remarks	Used to clarify SNOP code; used especially with site-specific lesions.
Treatment Code	Currently used as 4-character code to indicate experimental treatment group. Eventually this may be routinely available from the computer data banks of animal inventory.
Days Postexposure	Entered as right adjusted 4-digit number indicating age postexposure. This also may be routinely available in the future from within the computer.

SNOP CODING TUMORS

If the investigator consistently follows the conventions for completing the SNOP coding form, a minimum of error correction will be necessary prior to analysis of the experiment. However, recording the presence of a neoplastic lesion requires additional conventions to ensure that the tumor incidence tables allow meaningful comparison between treatment groups. The first of these guidelines is related to the last digit of the SNOP morphology code. As outlined on page xv of the SNOP dictionary, this digit is used to indicate the condition of the tumor. We have condensed these conditions into three categories: benign, malignant, and metastatic.

- Benign tumors (codes 0 or 1) - there is no logical restriction on the number of benign tumors which may be reported for each animal.
- Malignant tumors, primary site (codes 2,3,4 or 5) - if an animal exhibits malignancy, the system expects that there is at least one primary site. If the primary site is unknown, or if the lesion is diffuse, as in leukemia, enter T0001 (site unknown) as the location of the primary malignant lesion.
- Malignant tumors, secondary site (codes 6,7,8 or 9) - the system expects animals exhibiting metastatic tumors to have at least one primary site also. If not, the animal will not be included in the proper table of incidence (use T0000 if primary site is unknown).
- More than one primary tumor - the system has no method of differentiating between legitimate and erroneous records of an animal with more than one primary malignancy. It is credible for an animal to have a lung tumor and an osteosarcoma, which would be recorded as two tumors in the incidence summaries. However, records showing a carcinoma of the liver and also of the spleen probably refer to only one tumor. A proof-reading table of tumors is provided to help the investigator resolve these possible errors.

The second convention we have established in regard to recording tumors is the addition of a code for the number of tumors in a given tissue. If several nodules of the same tumor are recorded, the count might reflect a rather advanced tumor state. The code ranges from 1 to 9, with any number greater than 9 entered as 9. The editing and proofreading programs of the system check to see if the number of tumors agrees with the diagnosis. That is, it is "illegal" to record a number of tumors without a morphology code in the tumor series (M8000 and M9999). Similarly, it is "illegal" to enter a tumor morphology code without a valid number of tumors.

CONDENSING CODED RECORDS

Narrative descriptions and SNOP codes allow seemingly limitless lesion categories, however the goal of analyzing research results is to reduce the findings to a manageable number of categories. The SNOP topography codes are structured to allow general or specific site descriptions by using two or four digits of the code. Even though all four digits are recorded, the computer programs can group sites by the first two digits. This is not entirely satisfactory as some 2-digit codes are equivalent (both T01 and T02 are 2-digit codes for the skin). We have therefore developed the ability to consider various codes equivalent for summarizing purposes while preserving the original specific codes.

Condensing diagnosis codes (M, E, or F series) into general categories is performed by the pathologist. By examining the detailed listings of lesions, he or she can make decisions as to which diagnoses are biologically equivalent so as to allow pooling of differently SNOP coded lesions.

Probably very few conventions can be established, as each experimental study will have different criteria for combining the somewhat artificial subdivisions imposed on the data by the coding.

The pathologist can inspect the initial computer listings and select codes to combine for the final analysis. The form presented in Figure 3 is used to define equivalent codes. Once the data is edited, the summary programs are run for the final analysis.

Observer _____ Date _____

Expt. No. _____ Species _____

Original SNOP codes may be temporarily altered for summary reports. This form allows you to define more general codes to be equivalent to one or several more specific codes. Records may also be dropped using the "DROP" code.

Topography Codes

[illegible]

Diagnoses Codes

Original Code "E,F,M"										Optional Topography Qualifier										Desired Code "E,F,M"									
										T																			

FIGURE 3. SNOP Code Equivalents Form

REPORTS

There are four types of tabulations performed by the system:

- All observations for each animal (case histories)
- All animals for each lesion (list of observations)
- Observations in each treatment group (treatment summaries)
- Tumors in each treatment group (tumor incidence).

The first two are used primarily in editing and consolidating the SNOP codes, the last two in analysis of the investigation. Portions of these tabulations may be judiciously used as appendices to published reports. Each type of report is described in detail below.

CASE HISTORIES

The first computer program, SNOPl, prints reports which tabulate all observations about each individual animal. These case histories are printed one animal per page so that they may be included in the file folder for that animal. An example of a report for hypothetical Animal 100 is shown in Figure 4. After the animal identification, each SNOP coded observation is printed in sequence by date of observation and by anatomical location. Each observation produces a minimum of two printed lines. The first contains the location code and its English equivalent, as well as the severity code and number of tumors, if any. The second line contains the morphology, etiology, or function code associated with that location and its English equivalent. If the investigator qualified his observation with remarks, these appear as a third line.

Note that this report displays both the SNOP codes and their English equivalents. Subsequent analytical tables are produced according to the

SNOP CODED OBSERVATIONS				OBSERVATIONS ON INDIVIDUAL ANIMALS		
EXPT: 999(CRW)				SAMPLE OBSERVATIONS TO DEMONSTRATE OUTPUT		SPECIES: RATS
						TRMT: LOW
ANIMAL	TIME	TYPE	NO.	SNOP	GRADE	TOPOGRAPHY
NUMBER	DAYS	VATON	ORS	CODE	1-MIN	
					5-MAX	
100	0212			T66	0	APPENDIX
				M4010		
				RMRKS		
				HISTO NO. H01001 OBSERVED 8/20/74 BY CRW		
				INFLAMMATION FOCAL-NOS		
				APPENDICITIS		
				** ERROR IN ABOVE RECORD **		
				DIAGNOSIS TYPE NOT C.G. OR M		
MALIGNANT		MICRO	2	T0300	2	SUBCUTANEOUS TISSUE-NOS
				M8823		FIBROSARCOMA-NOS
		MICRO		T1000	2	
				F9999		
				RMRKS		
				EXAMPLE OF ILLEGAL NUMERIC CODE		
				** ERROR IN ABOVE RECORD **		
				TOPOGRAPHY CODE NOT IN DICTIONARY - T1000		
				DIAGNOSIS CODE NOT IN DICTIONARY - F9999		
BENIGN		MICRO		T1133		RIB
				M9200		OSTEOBLASTOMA
				** ERROR IN ABOVE RECORD **		
				MORPHOLOGY CODE M9200 INDICATES NUMBER OF TUMORS SHOULD BE GREATER THAN ZERO		
		MICRO		T25	3	TRACHEA
				M4010		
				RMRKS		
				INFLAMMATION FOCAL-NOS		
				TRACHEITIS		
		MICRO		T28	1	LUNG
				M4010		
				RMRKS		
				INFLAMMATION FOCAL-NOS		
				BRONCHOPNEUMONIA		

FIGURE 4. Case History for Hypothetical Animal 100 (SNOP1)

codes, but print only the English translations.

As shown in the example, the computer performs a considerable range of error-checking to help insure that the data conforms to the conventions for input described in Table I. To facilitate proof-reading, these error messages are also printed in a separate subreport of SNOPI as shown in Figure 5. As an aid to the Biometrics staff, the card containing the error is printed on the error report so that corrections may be easily annotated.

While this error report helps to insure that each SNOP coded observation is complete and logical, there is no way that the computer can insure that every lesion for each animal enters the system. It remains the investigator's responsibility to see that all pertinent observations are entered, and that the SNOP codes accurately reflect what was observed.

The sample case history also shows several tumors observed in this animal. Since many of our studies focus on tumor development, records indicating tumorous lesions are also printed in a subreport (Figure 6), which lists all observations of tumors in a given study. In the proof-reading stages of analysis, it is used to help standardize diagnostic terminology throughout the study (e.g., was the lesion coded M8013 "Carcinoma" really different from those coded M8034 "Undifferentiated Carcinoma"). This report provides the only summary which prints all tumorous lesions observed in a given animal (other reports list tumor incidence, but in a summarized form).

The sample tumor report illustrates another computer-performed error checking feature, as shown in the report of Animals 102, 104 and 105. The

SNOP CODED OBSERVATIONS ERROR MESSAGES FOR INDIVIDUAL ANIMALS

EXPT: 999(CRW) SAMPLE OBSERVATIONS TO DEMONSTRATE OUTPUT SPECIES: RATS TRMT: LOW

ANIMAL NO: 100 AGE: 0212

HISTO NO, H01001 OBSERVED 8/20/74 BY CRW

CARD IN ERROR: H1H01001DEBUG 100CRW 82074 T66 M40100 APPENDICITIS LOW 0212

ATTEMPTED TRANSLATION:

T66 0

INFLAMMATION FOCAL-NOS

M4010

INFLAMMATION FOCAL-NOS

RMKKS

APPENDICITIS

.. ERROR IN ABOVE RECORD ..
DIAGNOSIS TYPE NOT C,G,OR M

CARD IN ERROR: H1H00019DEBUG 100CRW 82074MT100F99992 EXAMPLE OF ILLEGAL NUMERIC CODE LOW 212

ATTEMPTED TRANSLATION:

MICRO T1000 2

F9999

RMKKS

EXAMPLE OF ILLEGAL NUMERIC CODE

.. ERROR IN ABOVE RECORD ..
TOPOGRAPHY CODE NOT IN DICTIONARY - T1000
DIAGNOSIS CODE NOT IN DICTIONARY - F9999

CARD IN ERROR: H1H01001DEBUG 100CRW 82074MT113M9210

LOW 212

ATTEMPTED TRANSLATION:

MICRO T1133

OSTEOBLASTOMA

M9200

OSTEOBLASTOMA

BENIGN

.. ERROR IN ABOVE RECORD ..
MORPHOLOGY CODE M9200 INDICATES NUMBER OF TUMORS SHOULD BE GREATER THAN ZERO

.....CORRECTIONS REQUIRED FOR ABOVE ANIMAL..... CORRECTED BY _____ DATE ____

ANIMAL NO: 101 AGE: 0099 NO OBVIOUS ERRORS FOR THIS ANIMAL HISTO NO, H00082 OBSERVED 20/ 8/74 BY CRW

ANIMAL NO: 102 AGE: 352

HISTO NO, H02356 OBSERVED 8/25/74 BY CRW

..... THE ANIMAL DESCRIBED ABOVE HAS AT LEAST ONE REPORTED METASTATIC TUMOR,
HOWEVER, NO PRIMARY MALIGNANT LESION WAS REPORTED!!!!
THIS SHOULD BE CORRECTED - IF PRIMARY SITE IS UNKNOWN ENTER TOPOGRAPHY CODE T0000.

.....CORRECTIONS REQUIRED FOR ABOVE ANIMAL..... CORRECTED BY _____ DATE ____

ANIMAL NO: 104 AGE: 187

HISTO NO, H05326 OBSERVED 8/27/74 BY CRW

..... THE ANIMAL DESCRIBED ABOVE HAS MORE THAN ONE PRIMARY MALIGNANT LESION,
THIS IS NOT NECESSARILY BAD, BUT USE CARE IN EVALUATION OF FINAL COMPUTER TABLES OF INCIDENCE.

FIGURE 5. Error Report (SNOP1)

SNOP CODED OBSERVATIONS TUMORS LISTED BY INDIVIDUAL ANIMALS

EXPT: 999(CRW) SAMPLE OBSERVATIONS TO DEMONSTRATE OUTPUT SPECIES: RATS

TRMT: LOW

ANIMAL	TIME	P.E.	TYPE	NO.	SNOP	GRADE	TOPOGRAPHY	DIAGNOSIS	REMARKS
NUMBER	DAYS	VATOW	OBSER	TUM	CODE	1-MIN	5-MAX		
100	212		MICRO	2	T0300	2	SUBCUTANEOUS TISSUE-NOS	HISTO NO. H00082 OBSERVED 8/20/74 BY CRW	
MALIGNANT					M8823			FIBROSARCOMA-NOS	
BENIGN			MICRO		T1133		RIB	OSTEOBLASTOMA	
					M9200				
102	352		MICRO	2	T1133	2	RIB	HISTO NO. H02356 OBSERVED 8/25/74 BY CRW	
BENIGN					M9200			OSTEOBLASTOMA	
METASTATIC			MICRO	1	T5950	1	PANCREATIC INTERSTITIAL TISSUE	CARCINOMA METASTATIC	
					M8016				

***** THE ANIMAL DESCRIBED ABOVE HAS AT LEAST ONE REPORTED METASTATIC TUMOR, HOWEVER, NO PRIMARY MALIGNANT LESION WAS REPORTED!!!! THIS SHOULD BE CORRECTED - IF PRIMARY SITE IS UNKNOWN ENTER TOPOGRAPHY CODE T0000.

104	137		MICRO	1	T1171		FEUR	HISTO NO. H05326 OBSERVED 8/27/74 BY CRW	
MALIGNANT					M9183			OSTEOSARCOMA-NOS	
MALIGNANT			MICRO	1	T2810		RIGHT LUNG-NOS	SQUAMOUS CELL CARCINOMA-NOS	
					M8073				

***** THE ANIMAL DESCRIBED ABOVE HAS MORE THAN ONE PRIMARY MALIGNANT LESION, THIS IS NOT NECESSARILY BAD, BUT USE CARE IN EVALUATION OF FINAL COMPUTER TABLES OF INCIDENCE.

105	0029		MICRO		T0704	3	SPLENIC RED PULP	HISTO NO. H00082 OBSERVED 7/12/74 BY CRW	
MALIGNANT					M8013			CARCINOMA-NOS	
MALIGNANT			MICRO		T5600	3	LIVER-NOS	CARCINOMA-NOS	
					M8013				

***** THE ANIMAL DESCRIBED ABOVE HAS MORE THAN ONE PRIMARY MALIGNANT LESION, THIS IS NOT NECESSARILY BAD, BUT USE CARE IN EVALUATION OF FINAL COMPUTER TABLES OF INCIDENCE.

4 OUT OF 5 ANIMALS WITH TUMORS IN TREATMENT GROUP LOW

FIGURE 6. Tumor Report (SNOP1)

records for Animal 102 indicate that a metastatic lesion was observed, although no record of a primary lesion was entered. Since this is illogical, the tissues should be re-examined or an entry of T0001 (body, general, no specific site, or site unknown) and the appropriate lesion code should be entered.

Animals 104 and 105 present another possible inconsistency: two primary tumors are reported, and the computer has no way of knowing whether this is logical. Animal 104 did, in fact, have a bone tumor in the leg and a lung tumor, but Animal 105 illustrates an error which would invalidate tables of tumor incidence. It is probably not true that there were two primary abdominal carcinomas in Animal 105. The tissues should therefore be re-examined to see if the tumor originated in the liver or the spleen.

These three reports printed by SNOPI are usually produced several times in the course of analysis of a study. The first few times they are used for proof-reading and editing, the final copy may be filed with other records for each animal. We also have the capability of producing microfiche copies of the final report for permanent, less voluminous storage.

LIST OF OBSERVATIONS FOR EDITING

The second type of report used in proof-reading is the inverse of the case history report. Whereas SNOPI lists all observations for a given animal, SNOP2 lists all animals in which a given observation is seen. We have used several techniques to condense this report to

manageable size: we first print a cross-reference table of animal identification, survival time and histology number as illustrated by Figure 7.

The cross-reference table permits us to refer to animals simply by their numbers in the main table, although an investigator may need the Histology Number to re-examine the slide. To further condense the main table of SNOP2, (Figure 8), records of normal conditions are omitted, and only the first two digits of the location code are considered unique; i.e., a reported observation of inflammation of the left lung (T2850) is combined with those reporting simply inflammation of the lung (T28).

The table is arranged in the same order as the SNOP dictionary, with topography code the major subdivision. Within each topography code (2-digit only), the etiology, function, and morphology codes are presented in numerical order. To aid in proof-reading, the actual SNOP codes are printed at the extreme right of the table.

The table is used for two primary purposes: (1) to detect miscoded observations, (for example, if atrophy of the thymus is listed, and it is known that thymus examination was not in the protocol, all the SNOP codes for that animal are suspect); (2) to aid in condensing the records; (e.g., if observations for the lung include "inflammation, NOS" in five animals, and "inflammation, diffuse, NOS" in three animals, and "inflammation, acute, focal" in another, one might wish to classify all nine animals as "inflammation, NOS"). One could change the records either permanently or temporarily to do this. The latter method is discussed in the "Condensing Coded Records" section of this publication (page 13).

SNOP CODED OBSERVATIONS EDITING REPORT LISTING ANIMALS WITH EACH LESION

EXPT: 162(JEB) 253ES INHALATION STUDY

SPECIES: RATS

TRMT GRP	ANIMAL	EXPT AGE	HISTO NO.	
-----	-----	-----	-----	
1	CONT	C11	588	PJ4148
2	CONT	C12	358	PJ3400
3	CONT	C13	800	PJ4959
4	CONT	C15	724	PD4604
5	CONT	C16	818	PD5043
6	CONT	C21	732	PD4617
7	CONT	C24	783	PD4958
8	CONT	C25	885	PD5034
9	CONT	C26	636	PD4498
10	CONT	C31	849	PD5050
11	CONT	C32	758	PD4602
12	CONT	C33	885	PD5036
13	CONT	C35	763	PD4953
14	CONT	C41	836	PD5047
15	CONT	C43	801	PD4965
16	CONT	C44	761	PD4975
17	CONT	C45	850	PD5053
18	CONT	C46	743	PD4575
19	CONT	C51	724	PD4608
20	CONT	C52	727	PD4612
21	CONT	C53	647	PD4368
22	CONT	C54	885	PD5032
23	CONT	C55	885	PD5031
24	CONT	C56	431	PD3687
25	CONT	C57	868	PD5051
26	CONT	C61	625	PD4404
27	CONT	C62	719	PD1536
28	CONT	C63	885	PD5038
29	CONT	C64	612	PD1180
30	CONT	C65	859	PD5052
31	CONT	C66	628	PD1398
32	CONT	C71	661	PD1403
33	CONT	C72	876	PD5042
34	CONT	C74	701	PD4489
35	CONT	C75	699	PD4497
36	CONT	C76	720	PD4487

FIGURE 7. Cross-Reference Table (SNOP2)

SNOP CODED OBSERVATIONS EDITING REPORT LISTING ANIMALS WITH EACH LESION

EXPT: 162(JEB) 253ES INHALATION STUDY

SPECIES: RATS

FIGURE 8. Table of Animals With Specific Lesions (SNOP2)

LOCATIONS AND DIAGNOSES	NO.	ANIMALS	
LUNG			
RADIATION INJURY-NOS	28	G116 G411 G412 G413 G414 G415 G416 G421 G422 G423 G424 G426 G431 G432 G433 G435 G436 G441 G442 G443 G444 G445 G446 G451 G452 G453 G454 G455	T28 M1130
CONGESTION-NOS	7	C24 C25 C44 C64 C65 G125 G173	M3810
EDEMA-NOS	2	G153 G173	M3840
SITE SPECIFIC INFLAMMATIONS	30	C12 C21 C22 C23 C31 C35 C41 C43 C45 C46 C51 C52 C54 C55 C56 C62 C63 C66 C71 C76 G111 G112 G114 G116 G121 G122 G123 G124 G126 G132 G133 G134 G136 G143 G145 G152 G154 G155 G156 G161 G162 G172 G173 G181 G186 G311 G313 G315 G316 G326 G331 G334 G335 G354 G364 G373 G376 G383 G433 G434 G451	M4000
INFLAMMATION FOCAL-NOS	1	G166	M4010
FIBROSIS-NOS	47	G62 G116 G161 G311 G312 G313 G314 G315 G316 G321 G322 G324 G331 G332 G333 G334 G335 G336 G342 G343 G344 G345 G346 G351 G352 G353 G354 G355 G356 G361 G362 G363 G365 G366 G374 G376 G382 G383 G384 G385 G386 G414 G421 G425 G433 G451	M4800
CHOLESTEROL DEPOSITION	2	C41 G161	M5524
DEPOSITION OF FOREIGN MATERIAL	1	G142	M5600
HEMOSIDERIN DEPOSITION	7	C16 C31 C56 G162 G163 G164 G331	M5731
HYPERPLASIA-NOS	1	G363	M7300
HYPERPLASIA ADENOMATOUS	12	G142 G316 G321 G325 G326 G345 G346 G352 G356 G375 G382 G386	M7308
METAPLASIA SQUAMOUS	6	G124 G313 G364 G415 G421 G433	M7520
METAPLASIA OSSEOUS	5	C13 C53 G311 G415 G445	M7540
HISTIOCYTOSIS-NOS	70	C13 C15 C16 C21 C24 C25 C26 C31 C32 C33 C35 C41 C43 C45 C46 C53 C54 C55 C57 C61 C62 C63 C64 C65 C66 C72 C74 G111 G115 G116 G121 G122 G124 G125 G126 G132 G133 G136 G142 G144 G151 G155 G156 G161 G162 G164 G166 G171 G172 G173 G181 G182 G183 G184 G315 G326 G342 G343 G346 G351 G352 G353 G356 G366 G374 G376 G381 G382 G383 G385	M7680
SQUAMOUS CELL CARCINOMA-NOS	1	G325	M8073
ADENOMA-NOS	3	G133 G322 G374	M8140
ADENOCARCINOMA-NOS	5	G121 G325 G326 G381 G382	M8143
PULMONARY ADENOMATOSIS T28	1	G113	M8251
SARCOMA-NOS	1	G131	M8803
FIBROSARCOMA - UNCERTAIN IF PRIMARY OR METASTATIC SITE	1	G182	M8829
HEMANGIOSARCOMA	1	G386	M9123
OSTEOSARCOMA-NOS	1	G362	M9183

TREATMENT GROUP SUMMARIES

The first analytical series of reports are prepared by SNOP3 and present a summary of incidence and average severity (graded 1 to 5) of each observation of animals in a given treatment group. Two tables are printed for each treatment group as well as a summary table comparing the treatments. The animals within a group are first ranked according to survival time, and assigned column and row coordinates for the second table. The first table, (Figure 9), lists the animal number histology number, experimental age, and coordinates. Using this table as a key, the investigator can determine, if necessary, the complete identification of a particular animal.

However, since the remainder of the reports are concerned with incidence and comparisons of treatments, individual identification is of secondary consideration; the second table (Figure 10) therefore reduces animals to a one-character code indicating the severity of any lesions. At the left of this table, each observation reported within a treatment group is printed. At the right, the severity codes are displayed, arranged from left to right in increasing order of survival time. Thus, time-related trends in the incidence and severity of a lesion within an experimental group of animals should be apparent. The center portion of this table contains the total incidence of a particular lesion and the average grade of severity.

After all diagnoses for a particular anatomical location are printed, a summary for that location is produced. This summary includes normal animals examined as well as those reported as having lesions. We have

SNOP CODED OBSERVATIONS DETAILED LESION INCIDENCE AND GRADES BY GROUP

EXPT: 162(JEB) 253ES INHALATION STUDY

SPECIES: RATS

TRMT: 3

THE FOLLOWING TABLE IS THE KEY TO THE TABLES WHICH SUMMARIZE OBSERVATIONS FOR AN ENTIRE TREATMENT GROUP. NOTE THAT ANIMALS ARE SORTED IN ASCENDING ORDER OF TIME TILL DEATH, THEN ASSIGNED ROW AND COLUMN INDICATORS. TO DETERMINE WHICH INDIVIDUAL ANIMAL HAD A SPECIFIC LESION IT IS NECESSARY TO USE THIS TABLE TO TRANSLATE ROW AND COLUMN VALUES BACK TO ANIMAL IDENTIFICATION NUMBERS

ANIMAL -----	EXPT AGE -----	COL. ----	ROW ---	HISTO NO. -----
G311	489	A	1	PD3768
G312	296	A	2	PD2942
G313	494	B	1	PD3769
G314	442	B	2	PD3694
G315	523	C	1	PD4048
G316	493	C	2	PD3770
G321	565	D	1	PD4073
G322	417	D	2	PD3609
G323	270	E	1	PD2906
G324	262	E	2	PD2903
G325	615	F	1	PD4179
G326	775	F	2	PD4955
G331	292	G	1	PD2940
G332	417	G	2	PD3608
G333	655	H	1	PD4369
G334	545	H	2	PD4049
G335	628	I	1	PD4410
G336	448	I	2	PD3695
G341	469	J	1	PD3706
G342	630	J	2	PD4400
G343	388	K	1	PD3527
G344	336	K	2	PD3238
G345	536	L	1	PD4050
G346	793	L	2	PD5041
G351	425	M	1	PD3618
G352	423	M	2	PD3619
G353	502	N	1	PD3792
G354	531	N	2	PD3856
G355	647	O	1	PD4370
G356	333	O	2	PD3161
G361	451	P	1	PD3699
G362	541	P	2	PD4051
G363	702	Q	1	PD4499
G364	524	Q	2	PD3821
G365	456	R	1	PD3702
G366	450	R	2	PD3696

FIGURE 9. Cross-Reference Table (SNOP3)

FIGURE 10. Detailed Lesion Incidence and Grades By Treatment Group (SNOP3)

SNOP CODED OBSERVATIONS		DETAILED LESION INCIDENCE AND GRADES BY GROUP																									
EXPT: 162(JEB) 253ES INHALATION STUDY		SPECIES: RATS																									
TRMT: 3																											
LOCATIONS AND DIAGNOSES		AVE, ANIMAL COORDINATES (SEE PAGE 1)																									
NO, GRADE		ROW	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
CONTINUED: LUNG																											
HEMOSIDERIN DEPOSITION	1 2	1							2																		
HYPERPLASIA ADENOMATOUS	11 2	1			2		1						2									2		1		1	
METAPLASIA SQUAMOUS	1 2	1		2				2					2	2		2											
METAPLASIA OSSEOUS	1 1	1																									
HISTIOCYTOSIS-NOS	16 2	1			1							3		2	3						2		2	2	2		
SQUAMOUS CELL CARCINOMA-NOS	1	1						2			3	3	2	2		2				2		2	3	2			
ADENOMA-NOS	2	1																									
ADENOCARCINOMA-NOS	3	1																									
HEMANGIOSARCOMA	1	1																									
OSTEOSARCOMA-NOS	1	1																									
OSTEOSARCOMA - METASTATIC SITE	16	1																									
LYMPHOMA, METASTATIC SITE	2	1																									
CHLOROMA, METASTATIC SITE	2	1																									
SUMMARY FOR: LUNG																											
0 NORM(N) 48 ABNORM(=) 0 NOT EXAM(?)																											
PLEURA																											
HYPERPLASIA-NOS	1 2	1																									
		2																									

followed the convention that if a record is not entered into the system the tissue was not examined; we do not assume that a tissue was normal if no record was submitted.

The final table printed by SNOP3 (Figure 11), compares treatment groups, printing the incidence and average grade of each reported lesion type. It also contains a summary of anatomical locations, giving the number of normal, abnormal, and not-examined animals in each treatment group. The right-hand column contains the totals for the entire investigation.

TUMOR INCIDENCE

Since tumors are often the lesions most important to us for evaluation of experimental results, a set of four reports, similar to the treatment group summaries but limited to tumors, is printed by SNOP4, bringing together all SNOP coded tumor records (codes M8000 to M9999) to allow analysis of the types and incidence of tumors in the various treatment groups. These reports take advantage of the tumor classification built into the fourth (right-most) digit of the SNOP morphology codes for tumors. After consultation with our pathologists, we pooled these into three categories:

- benign - coded 0 or 1
- malignant, primary site - codes 2,3,4, or 5
- malignant, metastatic site - codes 6,7,8 or 9.

The first report printed by SNOP4 is a table of tumors within these three categories. Figure 12 is an example of a malignant, primary site table. Tumor types are printed at the left and detailed animal identifi-

SNOP CODED OBSERVATIONS SUMMARY OF LESION INCIDENCE AND GRADES BY GROUP

EXPT: 162 (JEB) 253ES INHALATION STUDY

SPECIES: RATS

LOCATIONS AND DIAGNOSES	GROUP: SIZE	1 3 4 ALL			
		36	45	48	29 158
CONTINUED: LUNG					
FIBROSARCOMA - UNCERTAIN IF PRIMARY OR METASTATIC SITE	NUMBER AV GRADE		1		
HEMANGIOSARCOMA	NUMBER			1	
OSTEOSARCOMA-NOS	NUMBER			1	
OSTEOSARCOMA - METASTATIC SITE	NUMBER			16	1
LYMPHOMA, METASTATIC SITE	NUMBER			2	
LYMPHOCYTIC SARCOMA - METASTATIC SITE	NUMBER AV GRADE		2		
LEUKEMIA, METASTATIC SITE	NUMBER	1			
CHLOROMA, METASTATIC SITE	NUMBER			2	
SUMMARY FOR: LUNG	NORMAL ABNORMAL NOT EXAM	2 34 0	3 42 0	0 48 0	0 29 0 5 153
PLEURA					
SITE SPECIFIC INFLAMMATIONS	NUMBER AV GRADE		1 2		
HYPERPLASIA-NOS	NUMBER AV GRADE			1 2	
SUMMARY FOR: PLEURA	NORMAL ABNORMAL NOT EXAM	0 0 36	0 1 44	0 1 47	0 0 29 0 156

FIGURE 11. Summary Of Lesion Incidence And Severity By Treatment Group (SNOP3)

SNOP CODED OBSERVATIONS TUMOR INCIDENCE IN INDIVIDUAL ANIMALS

EXPT: 162(JEB) 253ES INHALATION STUDY

SPECIES: RATS

MALIGNANT TUMOR TYPES	LOCATIONS	TRMT CODE	ANIMAL NUMBER	TIME P.E. DAYS	TYPE OBSER VATION	GRADE 1-MIN 5-MAX	NO. TUM ORS
CONTINUED: ADENOCARCINOMA-NOS	LUNG	3	G382	634	MICRO	0	1
	STOMACH	1	G111	707	MICRO	0	1
THYMOMA MALIGNANT 1T98	THYMUS		C21	732	MICRO	0	1
SARCOMA-NOS	BONE	1	G162	757	MICRO	0	1
	LUNG	1	G131	550	MICRO	0	1
FIBROSARCOMA-NOS	SUBCUTANEOUS TISSUE	1	G132	688	MICRO	0	2
	BONE	1	G165	745	MICRO	0	1
	HEART	1	G173	502	MICRO	0	1
	PANCREAS EXCEPT ISLETS	1	G164	724	MICRO	0	1
	URINARY BLADDER		C57	868	MICRO	0	1
	LOWER EXTREMITY		C61	625	MICRO	0	1

FIGURE 12. Tumor Incidence Report (SNOP4)

cation, including treatment code, animal number, survival time, severity and number of tumors, is printed at the right.

The second report is subdivided by treatment groups, and contains one line for each animal, giving animal identification and category of any tumor (Figure 13).

The third and fourth reports summarize tumor incidence in the various treatment groups: by category (Figure 14) and by total counts of tumors and total counts of animals having one or more tumors (Figure 15).

Animals with more than one tumor are counted in each category; however, if the conventions outlined in the section entitled "SNOP Coding Tumors" are followed, each malignant tumor will truly represent an unrelated neoplasm.

SNOP CODED OBSERVATIONS

TUMOR INCIDENCE IN INDIVIDUAL ANIMALS

EXPT: 162 (JEB) 253ES INHALATION STUDY

SPECIES: RATS

FIGURE 13. Tumor Incidence Summary Table (SNOP4)

TRMT GRP	ANIMAL	EXPT AGE	HISTO NO.	BENIGN	MALIGNANT	METASTATIC
1	G311	489	PD3768			
2	G312	296	PD2942		•	•
3	G313	494	PD3769	•		
4	G314	442	PD3694		•	•
5	G315	523	FC4048		•	•
6	G316	493	PD3770		•	
7	G321	565	FC4073		•	•
8	G322	417	FC3609	•	•	
9	G323	270	FC2906		•	•
10	G324	262	FC2903		•	•
11	G325	615	FC4179		•	
12	G326	775	FC4955		•	
13	G331	292	PC2940			
14	G332	417	FC3608		•	•
15	G333	655	PC4369	•		
16	G334	545	PD4049			
17	G335	628	PD4410	•		
18	G335	448	PD3695			
19	G341	469	PD3706		•	•
20	G342	630	PD4400			
21	G343	388	PD3527		•	
22	G344	336	PD3238		•	•
23	G345	536	PD4050		•	•
24	G345	793	PD5041		•	
25	G351	425	PD3618	•		
26	G352	423	PD3619		•	•
27	G353	502	PD3792	•	•	•
28	G354	531	PD3856			
29	G355	647	PD4370			
30	G356	333	PD3161		•	•
31	G361	451	PD3699	•	•	•
32	G362	541	PD4051		•	
33	G363	702	PD4499		•	•
34	G364	524	PD3821			
35	G365	456	PD3702		•	•
36	G366	450	PD3696		•	•
37	G371	336	PD3237		•	•

SNOP CODED OBSERVATIONS		SUMMARY OF TUMOR INCIDENCE BY GROUP				
EXPT: 162(JEB) 253ES INHALATION STUDY		SPECIES: RATS				
MALIGANT TUMORS AND LOCATIONS		GROUP: SIZE:	1 36	3 45	4 48	ALL 29 158
-----			----	----	----	----
CARCINOMA-NOS						
KIDNEY					2	2
ISLETS OF LANGERHANS					2	2
SQUAMOUS CELL CARCINOMA-NOS						
SKIN				1		1
SKIN CONTINUED			1			1
LUNG					1	1
TRANSITIONAL CELL CARCINOMA						
KIDNEY					2	2
ADENOCARCINOMA-NOS						
BREAST				1	1	2
LUNG				1	3	4
STOMACH				1		1
THYMOMA MALIGNANT IT98						
THYMUS			1			1
SARCOMA-NOS						
BONE				1		1
LUNG				1		1
FIBROSARCOMA-NOS						
SUBCUTANEOUS TISSUE				2		2
BONE				1		1
HEART				1		1
PANCREAS EXCEPT ISLETS				1		1
URINARY BLADDER			1			1
LOWER EXTREMITY			1			1
LIPOSARCOMA-NOS						
ABDOMINAL VISCERA					1	1

FIGURE 14. Tumor Incidence Treatment Group Comparison (SNOP4)

SNOP CODED OBSERVATIONS

SUMMARY OF TUMOR INCIDENCE BY GROUP

EXPT: 162(JEB) 253ES INHALATION STUDY

SPECIES: RATS

SUMMARY COUNTS		GROUP: SIZE	1 36	3 45	4 48	ALL 29 158
ANIMALS WITH BENIGN TUMORS			9	8	12	1 30
NUMBER OF	BENIGN TUMORS		10	8	15	1 34
ANIMALS WITH MALIGNANT TUMORS			6	13	32	1 52
NUMBER OF	MALIGNANT TUMORS		14	17	39	1 71
ANIMALS WITH METASTATIC TUMORS			1	5	21	1 28
ANIMALS WITH NON-METAS. TUMORS			15	19	37	2 73
NUMBER OF	NON-METAS. TUMORS		24	25	54	2 105

FIGURE 15. Grand Totals Of Tumor Incidence (SNOP4)

COMPUTER SYSTEM

Computer programs were written in FORTRAN for a Control Data Corporation (CDC) CYBER computer operating under SCOPE 3.4. This section describes data files, programs and production deck setups to aid computerists in using the system. Although standard FORTRAN was used as much as possible, the following areas represent machine-dependent CDC-CYBER characteristics of the system:

- 60-bit word length
- CDC compass functions to compare and manipulate characters
- CDC record manager routines to access the SNOP dictionary and data files
- CDC SORTMRG routines to manipulate data files.

We have attempted to incorporate a sufficient number of comment cards within each program to make the program listings self-evident. These listings (on microfiche) appear as Appendix A; punched card copies of the SNOP programs are available on request. The following section consists of documentation describing how to set up and run each program, as well as general run diagrams and flowcharts.

The overall flowchart for the system is present in Figure 16. SNOP1 creates condensed data files from the H1 input data for use by SNOP2, SNOP3 and SNOP4. All corrections and additions to the data base must be performed by submitting H1 cards to SNOP1 with subsequent merging into existing data files. It is anticipated that the SNOP1 program possibly coupled with SNOP2, will be run several times to get the data base complete

and acceptable to users. After examining original runs from SNOP3 and SNOP4, users may want to condense lesion descriptions further for the final report. These temporary changes can be performed by SNOP5/SNOP6 which create modified files to be rerun on SNOP3 and SNOP4.

FILE STRUCTURES

The data files, either cards or mass storage, are segregated by experimental groups for efficiency in analysis. The files are identified by a unique three-character suffix associated with standard file names. In the description, "XXX" is used to represent these identifiers, although different characters (such as investigators' initials) would be used for each data set established. Data files are maintained on disk files during active analysis, then transferred to tape files for storage.

The SNOP dictionary containing English equivalents is maintained on a disk utilizing a Direct Address file organization. Each record contains the 5-character code (E, F, M or T prefix and 4-digit code) and a 1- to 75-character English translation. The file was created from and is updated from punched cards, using the Systematized Nomenclature of Pathology dictionary as a guide. Only the preferred terms were entered with synonyms, and site-specific terms are not included. Some deviations from the standard codes are being used to accommodate our particular needs; these are entered in a master SNOP handbook maintained by the Biometrics Center after the changes are approved by the users.

Figure 17 presents the parameters and characteristics of the file. Program CHANGE is used to update the file, while access is accomplished by calls to the SNOPS subroutine. In both cases the FORTRAN callable

Record Format (cards, mass storage or KSNOP array)

Code Prefix (T, M, E, F)	A1	1
SNOP Code (Numeric with X's and Y's)	A4	2-5
English equivalent	7A10,A5	6-80

Parameters (used by CDC Record Manager Routines)

File Organization	FO	DA
Logical File Name	LFN	SNOP
Record Type	RT	W
Minimum Record Length	MNR	5
Maximum Record Length	MRL	80
Record Key Word	RKW	0
Record Key Position	RKP	0
Key Length	KL	5
Home Blocks	HMB	1000
Maximum Block Length (Characters)	MBL	630
Records Per Block (average)	RB	15

Creation - punched cards submitted to program CREATE.

Updating - additions, replacements or deletions performed by program CHANGE along with a SCOPE card to EXTEND the file.

Backup (using Tape Reservation System)

```
ATTACH (SNOP, SNOPCODE, ID=BNW331
TAPESET (SNORCODES, ID=BNW331, W=SNOPCODES, NC=2, RET=999, PRUGE)
TAPE (SNOPTAP, SNOPCODES, ID=BNW331, W=SNOPCODES)
COPY (SNOP, SNOPTAP)
SAVETAP (SNOPTAP)
```

Access (utilizes subroutine SNOPS)

COMMON /BLKSNOP/	SNOPFIT(35), KSNOP(8), LSNOP, KEYSNOP, KEYNEXT	Record Manager Array Working Array Length in characters Code to look up Next code to look up Opens file at beginning
CALL OPNSNOP		
KEYSNOP = KCODE		Set code to look up
CALL GETSNOP		Looks up English equivalent and fills KSNOP array accord- ing to record format
CALL CLSSNOP		Closes file at end

FIGURE 17. SNOP Dictionary Characteristics

routines to RECORD MANAGER are used to get, put, replace and delete records from the file, which is copied to magnetic tape for backup.

The form H1 (Figure 2 and description on page 9) is filled out by users and submitted to the Biometrics Center for processing. It is key-punched to produce one card for each lesion or coded observation (Figure 18). The forms are then accumulated, by experiment, until the investigator requests a report. The cards are subsequently inputted to SNOPI, after which they are filed for backup. The program SNOPI creates SNOPI, TUMRXXX and IDNTXXX files (Figures 18 and 19) which are the basis for the other programs. Errors are generally corrected in the backup deck and a duplicate card reentered to the program SNOPI to generate correct records for the IDNTXXX, SNOPI, and TUMRXXX files. These additional records are merged into the existing files with SORTMRG.

The IDNTXXX file consists of one record per animal to provide animal treatment, age and histology number for reference in each of the reports (Figure 18). The information is currently obtained entirely from the H1 forms, although eventually the treatment and age data could be obtained from a computer managed inventory of experimental animals.

All coded observations are stored in the SNOPI file in a condensed format (Figure 19). The "remarks", "date observed" and "observer" (Form H1) are not stored -- users must reference the SNOPI report for them. Although the TUMRXXX file is in the same format as SNOPI, it is limited to neoplastic lesions coded M8000 to M9999.


```

C-----BNW
C----- "SNOPXXX" WRITTEN TO TAPE7 FORMATTED INTO 2 WORDS BNW
C BNW
C ---CHARACTER FIELD BNW
C COUNT DESCRIPTION BNW
C 1 "T" TOPOGRAPHY CODE PREFIX BNW
C 2-5 TOPOGRAPHY CODE BNW
C 6 "E", "F", OR "M" DIAGNOSIS CODE PREFIX BNW
C 7-10 DIAGNOSIS CODE BNW
C 11-15 ANIMAL IDENTIFICATION (USUALLY NUMERIC BUT A5 INPUT) BNW
C 16 "C", "G", OR "M" TYPE OF DIAGNOSIS CODE BNW
C 17 GRADE OF LESION (1-5, 0= NOT GRADED) BNW
C 18 NUMBER OF TUMORS IF ANY, 9 = MULTIPLE BNW
C 19 RESERVED FOR FUTURE USE BNW
C 20 RESERVED FOR FUTURE USE BNW
C BNW
C FILE CHARACTERISTICS - BT=C, RT=Z, FL=20 BNW
C STANDARD SORT ORDER AS CATALOGED AND USED BY SNOP PROGRAMS BNW
C TOPOGRAPHY CODE (2 DIGIT), DIAGNOSIS CODE, ANIMAL NUMBER BNW
C BNW
C----- "TUMRXXX" WRITTEN TO TAPE8 FORMATTED INTO 2 WORDS BNW
C BNW
C 1 "T" TOPOGRAPHY CODE PREFIX BNW
C 2-5 TOPOGRAPHY CODE BNW
C 6 "M" DIAGNOSIS CODE PREFIX BNW
C 7-10 DIAGNOSIS CODE (LIMITED TO M8000 THRU M9999) BNW
C 11-15 ANIMAL IDENTIFICATION (USUALLY NUMERIC BUT A5 INPUT) BNW
C 16 "C", "G", OR "M" TYPE OF DIAGNOSIS CODE BNW
C 17 GRADE OF LESION (1-5, 0= NOT GRADED) BNW
C 18 NUMBER OF TUMORS IF ANY, 9 = MULTIPLE BNW
C 19 RESERVED FOR FUTURE USE BNW
C 20 RESERVED FOR FUTURE USE BNW
C BNW
C FILE CHARACTERISTICS - BT=C, RT=Z, FL=20 BNW
C STANDARD SORT ORDER AS CATALOGED AND USED BY SNOP PROGRAMS BNW
C TUMOR TYPE (4TH DIGIT OF DIAGNOSIS CODE), DIAGNOSIS CODE, BNW
C TOPOGRAPHY CODE (2 DIGIT), ANIMAL NUMBER BNW
C BNW
C----- FILE BACK-UP PROCEDURE FOR IDNTXXX, SNOPXXX, AND TUMRXXX -----BNW
C----- USE TAPE RESERVATION SYSTEM CONTROL CARDS FOR MAGNETIC TAPE BNW
C----- XXX REPRESENTS INVESTIGATORS INITIALS FOR IDENTIFICATION BNW
C----- YYY REPRESENTS EXPERIMENT NUMBER NEEDED FOR LONG TERM STORAGE BNW
C BNW
C TAPESET(SNOPDATAAXXXYYY,ID=BNW331,W=BNW331,NC=2,RP=999,PURGE) BNW
C TAPE(SNOPTAP,SNOPDATAAXXXYYY,ID=BNWW BNW
C COPYBF(IDNTXXX,SNOPTAP) BNW
C COPYBF(SNOPXXX,SNOPTAP) BNW
C COPYBF(TUMRXXX,SNOPTAP) BNW
C SAVTAPE(SNOPTAP) BNW
C BNW
C----- PROCEDURE FOR RESTORING FILES FROM BACK-UP TAPE FILE -----BNW
C BNW
C TAPE(SNOPTAP,SNOPDATAAXXXYYY,ID=BNW331) BNW
C COPYBF(SNOPTAP,IDNTXXX) BNW
C COPYBF(SNOPTAP,SNOPXXX) BNW
C COPYBF(SNOPTAP,TUMRXXX) BNW
C BNW
C-----BNW

```

FIGURE 19. SNOPXXX And TUMRXXX File Characteristics

PARAMETER CARD

A parameter card defining the type of report format and the experiment characteristics is a necessary input to all SNOPI, SNOPI2, SNOPI3 and SNOPI4. The format of this card is shown in Figure 20.

```

C-----BNW
C                                           BNW
C-----  PARAMETER CARD                      BNW
C           (REQUIRED FOR SNOPI, SNOPI2, SNOPI3, AND SNOPI4) BNW
C                                           BNW
C           NUMBER OF PARAMETER CARDS -      BNW
C           FIELD IDENTIFICATION OF PARAMETER CARDS - BNW
C                                           BNW
C           COL.   FORMAT   NAME   DESCRIPTION BNW
C           KEXPT   A4     COL 1-4   EXPERIMENT NUMBER BNW
C           INIT    A3     COL 6-9   INVESTIGATORS INITIALS BNW
C           KSPEC   A10    COL16-25  SPECIES OF ANIMAL BNW
C                                           BNW
C                                           (USED AS OUTPUT, NOT FOR BNW
C                                           CHECKING RECORDS) BNW
C           MLINE   I2     COL27-28  NUMBER OF LINES PER PAGE BNW
C                                           IF .NE. 66, WILL BE SET TO 51 BNW
C                                           USER MUST ALSO USE CONTROL CARDS BNW
C                                           TO CONTROL DISPOSITION OF "REPORT" TO BNW
C                                           PRINTER EQUIPED WITH TYPE PAPER BNW
C                                           DESIRED. (USE COPYCR TO PUT PM AT BNW
C                                           HEAD OF REPORT) BNW
C           ITUMR    I1     COL 29    0 = ALL TYPES OF TUMORS TO "TUMORS" BNW
C                                           1 = ONLY PRIMARY BNW
C                                           2 = PRIMARY + METASTATIC BNW
C                                           3 = ONLY BENIGN BNW
C                                           4 = NO "TUMORS" FILE WRITTEN BNW
C           IFPAGE   I1     COL 30    IF .NE. 0 WILL NOT START NEW BNW
C                                           PAGE FOR EACH ANIMAL BNW
C           TITLE(1) A10    COL 31-40  DESCRIPTIVE TITLE OF EXPERIMENT BNW
C           TITLE(2) A10    COL 41-50  DESCRIPTIVE TITLE OF EXPERIMENT BNW
C           TITLE(3) A10    COL 51-60  DESCRIPTIVE TITLE OF EXPERIMENT BNW
C           TITLE(4) A10    COL 61-70  DESCRIPTIVE TITLE OF EXPERIMENT BNW
C-----BNW

```

FIGURE 20. Parameter Card Format

SNOP1

SNOP1 is the foundation program used to read new data and to create appropriate files for input to other report generating programs. A typical sequence of processing a set of data with SNOP1 would be:

- Submit keypunched H1 forms to SNOP1, as outlined by Figure 21,
- Have pathologist check errors and verify completeness of data,
- Rerun SNOP1 and run SNOP2 for additional error checking and editing,
- Correct any remaining errors,
- Rerun SNOP1 for final case history reports, microfiche copy and creation of data files including tape backup,
- If any other changes are needed or new data added, submit just those cards to SNOP1 and merge resulting records into existing files.

At this point the complete and correct data files are ready to be submitted to SNOP2, SNOP3 or SNOP4 for report generation.

The flowchart and program abstract are presented in Figures 22 and 23. The characteristics of the H1 form are discussed on page 8; output reports are described starting on page 15. A parameter card is necessary as outlined in Figure 20 which can generally be used for all the programs. SNOP1 also may read a dictionary of treatment code equivalents to modify the treatment codes entered on the H1 forms. This allows setting several codes equal to a common code such as changing C, CON or CONT all to CONT which would insure all the control animals would be grouped together in subsequent

FIGURE 21. SNOP1 Run Diagram

SNOP1 - CREATES FILES, CHECKS FOR ERRORS, PRINTS REPORT BY ANIMAL

FIGURE 22. SNOP1 Flowchart

```

C-----BNW
C          BATTLE NORTHWEST -----BNW
C          SYSTEMS DEPARTMENT -----BNW
C          STATISTICS SECTION -----BNW
C          BIOMETRICS OPERATION -----BNW
C-----BNW
C          PROGRAM ABSTRACT -----BNW
C
C  PROGRAM NAME - S N O P 1 BNW
C  ORIGINAL PROGRAMER - DICK OLSON / CHUCK WATSON BNW
C  DATE WRITTEN - JULY 1974 BNW
C  PROGRAM LANGUAGE - FORTRAN, SORTMRG, RECORD MNGR BNW
C  ESTIMATED RUN FREQUENCY - ON DEMAND BNW
C  APPROXIMATE RUN TIME - 20-60 SEC, 70000 CM BNW
C  PROGRAM DESCRIPTION - PROCESSES SNOP CODED HISTOPATH DATA BNW
C                          READS NEW INPUT, CHECKS FOR ERRORS BNW
C                          PRINTS ONE PAGE SUMMARY PER ANIMAL BNW
C                          WITH ENGLISH VERSION OF SNOP CODES BNW
C                          CREATES CONDENSED RECORDS FOR STORAGE BNW
C
C  MAIN CALCULATIONS - COUNTS, REPORT GENERATION BNW
C  INPUT ORIGINATES FROM - H1 FORMS FILLED OUT BY PATHOLOGISTS BNW
C  TAPES REQUIRED - NONE BNW
C  FILES REQUIRED - PROGRAMS LIB769, ID=BNW331 BNW
C                          DICTIONRY SNOPCODE, ID=BNW331 BNW
C
C  FILES TO BE CATALOGED - DATA SNOPI1, SNOPI1XXX, ID=BNW331 BNW
C                          DATA SNOPI1NEW, SNOPI1XXX, ID=BNW331, BNW
C                          DATA TUMRNEW, TUMRXXX, ID=BNW331, BNW
C                          DATA IDNTNEW, IDNTXXX, ID=BNW331, BNW
C
C  OUTPUT - LINE PRINTER (USUALLY 2 PART SMALL) BNW
C
C  DELIVER OUTPUT TO - MICROFICHE, DISK FILES BNW
C                          PATHOLOGIST REQUESTING REPORT BNW
C
C          DECK SETUP -----BNW
C
C  GROUP PARAMETER CARD BNW
C
C  DECK OF TREATMENT CODES, ONE CARD PER TREATMENT BNW
C
C  7/8/9 MULTIPUNCHED IN COL 1 "END OF FILE CARD" BNW
C
C  SNOP CODED RECORDS (FORM H1) BNW
C  ***USUALLY USE SORTMRG TO SORT --EQUATE SORTED FILE TO TAPE4 BNW
C  ***SORT ORDER OF CARDS --TRMT, ANIMAL, TOPOGRAPHY, DIAGNOSIS BNW
C
C  BLANK CARD TO SIGNAL END OF GROUP BNW
C
C  MAY REPEAT SEVERAL GROUPS BNW
C
C  6/7/8/9 END-OF-JOB-CARD BNW
C-----BNW

```

FIGURE 23. SNOPI Program Abstract

reports. The first character on each dictionary card is used to determine the output order of treatment groups in summary programs. If no dictionary is used, the treatment codes will be taken from the H1 records and arranged alphabetically in the various reports. The format for these cards (one per treatment) is:

Col 1	Character determining order of treatments in reports
Col 2-5	Desired 4 character treatment code to appear on reports
Col 6-10	Various 4 character codes equivalent to desired code and
11-15	converted to the code in columns 2-5. A total of 15
16-20	variations of the desired code can be entered (15(A4,1X)).
...	
76-80	

Considerable file handling is performed in a SNOP1 run as the input data is sorted and output files are sorted or sort-merged before cataloging as permanent files. The standard sort order for the various files are:

- SNOPH1 (H1 format)
Treatment, animal number, observation date, topography code, diagnosis code
- IDNTXXX (Animal identification)
Treatment, experimental age, animal number
- SNOPXXX (All lesions)
Topography code (2 digit), diagnosis code, animal number
- TUMRXXX (Tumor lesions)
Tumor type, diagnosis code, topography code (2 digit), animal number

The program has extensive error checking and message writing to detect problems in the data. We have used logical variables to indicate errors and to determine which messages to print. Records with errors will not be

written to the condensed files and the data analyst must resolve these errors with the pathologist before the data base can be completed. The rekeypunched, corrected cards are resubmitted to SNOPI and the resulting records merged into the original files rather than reprocessing the entire set of data each time another error is found.

SNOPI2

The SNOPI2 program generates a list of all lesions in an experimental group to be used for editing purposes (see page 21). Figure 24 shows the deck set up and associated input/output files while the flowchart and abstract are presented in Figure 25 and 26. The program accumulates animal numbers in an array for each lesion (Figure 25). When a different lesion type is read from the SNOPIXXX file, the preceding lesion is decoded and printed along with the array of accumulated animal numbers. Morphologically normal (M0001) observations are skipped in the printout to condense the output.

The cross-reference tables in SNOPI2, SNOPI3 and SNOPI4 are created by a call to SNOPIID which reads IDNTXXX and saves the animal numbers in arrays (Appendix A). Subroutine SNOPIID will cause abnormal program termination if more than 15 treatment groups or more than 1000 animals are processed. This routine creates indices arranged by animal number that point to the individual's original input sequence arranged by treatment and age post exposure. Subroutine SNOPISRT performs an internal "shell" sort to arrange the animal numbers while subsequent calls to subroutine BINSRCH

FIGURE 24. SNOP2 Run Diagram

SNOP2 - LISTS ALL LESIONS IN GROUP

A. Internal Routine

FIGURE 25. SNOP2 Flowchart

C	-----			BNW
C		-----		BNW
C		BATTELLE NORTHWEST	-----	BNW
C		SYSTEMS DEPARTMENT	-----	BNW
C		STATISTICS SECTION	-----	BNW
C		BIOMETRICS OPERATION	-----	BNW
C	-----			BNW
C		-----		BNW
C		PROGRAM ABSTRACT	-----	BNW
C	PROGRAM NAME -	S N O P 2		BNW
C	ORIGINAL PROGRAMER -	DICK OLSON / CHUCK WATSON		BNW
C	DATE WRITTEN -	JULY 1974		BNW
C	PROGRAM LANGUAGE -	FORTRAN, SORTMRG, RECORD MNGR		BNW
C	ESTIMATED RUN FREQUENCY -	ON DEMAND		BNW
C	APPROXIMATE RUN TIME -	20-60 SEC, 70000 CM		BNW
C	PROGRAM DESCRIPTION -	PROCESSES SNOP CODED HISTOPATH DATA		BNW
C		PRINTS SORTED LESION LIST FOR EDITING		BNW
C		WITH ENGLISH EQUIVALENTS OF SNOP CODES		BNW
C	MAIN CALCULATIONS -	COUNTS, REPORT GENERATION		BNW
C	INPUT ORIGINATES FROM -	FILES CREATED BY SNOPI PROGRAM		BNW
C	TAPES REQUIRED -	NONE		BNW
C	FILES REQUIRED -	PROGRAMS LI8769, ID=BNW331		BNW
C		DICTIONRY SNOPCODE, ID=BNW331		BNW
C		DATA SNOPNEW, SNOPXXX, ID=BNW331,		BNW
C		DATA IDNTNEW, IDNTXXX, ID=BNW331,		BNW
C	FILES TO BE CATALOGED -	NONE		BNW
C	OUTPUT -	LINE PRINTER (USUALLY 2 PART SMALL)		BNW
C	DELIVER OUTPUT TO -	PATHOLOGIST DEMANDING REPORT		BNW
C				BNW
C	-----	DECK SETUP	-----	BNW
C				BNW
C	GROUP PARAMETER CARD			BNW
C				BNW
C	6/7/8/9	END-OF-JOB-CARD		BNW
C	-----			BNW

FIGURE 26. SNOP2 Program Abstract

looks up animal numbers in the index arrays (Appendix A). This routine utilizes a binary searching technique.

SNOP3

Tables for comparative analysis of the incidence and severity of lesions are produced by SNOP3. This program performs detailed tabulations to determine which individuals are completely "normal" or those with one or more lesions (see page 25). The deck set up and associated input/output files are shown in Figure 27; the flowchart and program abstract in Figures 28 and 29.

SNOP3 writes separate output files for each treatment group plus a summary report to an additional file. SCOPE file handling cards are used to copy these separate reports to a common print file which can be printed or disposed to microfiche. The maximum number of output files (i.e. treatment groups) is 14, with a 15th used for summary tables. Increasing this will require changing the program card and re-compiling SNOP3 along with revising the SCOPE deck.

This program also uses the subroutines SNOPIID, SNOPTSRT, and BINSRCH as described under SNOP2 to arrange data from individuals according to increasing ages post-exposure. All observations, whether normal, pathogenic or neoplastic, are included in this report to allow proper calculation of the incidence of various lesions.

FIGURE 27. SNOP3 Run Diagram

SNOP3 - SUMMARIZES INCIDENCE OF LESIONS IN TREATMENT GROUPS

A. Internal Routine

FIGURE 28. SNOP3 Flowchart

SNOP 4

Tables for comparing the incidence of neoplastic changes are printed by SNOP4. The usefulness of this program depends on the pathologist following the conventions described on page 11. The output records are described on page 27 and include tables of the number of tumors and number of animals with tumors. The program makes these tables assuming that if there is more than one tumor record per animal the tumors are truly independent. This convention is reasonable with primary malignant sites but the counts for benign or metaplastic neoplasms must be interpreted knowing that several or many related benign or metastatic lesions may be observed within various organs of the same animal.

Figure 30 presents the deck set up input/output files while the flowchart and program abstract are given in Figures 31 and 32.

FIGURE 30. SNOP4 Run Diagram

SNOP.4 - SUMMARIZES INCIDENCE OF TUMORS III GROUPS

FIGURE 31. SNOP4 Flowchart

C	-----		BNW
C	-----	BATTELLE NORTHWEST	BNW
C	-----	SYSTEMS DEPARTMENT	BNW
C	-----	STATISTICS SECTION	BNW
C	-----	BIOMETRICS OPERATION	BNW
C	-----		BNW
C	-----	PROGRAM ABSTRACT	BNW
C	-----		BNW
C	PROGRAM NAME -	S N O P 4	BNW
C	ORIGINAL PROGRAMER -	DICK OLSON / CHUCK WATSON	BNW
C	DATE WRITTEN -	JULY 1974	BNW
C	PROGRAM LANGUAGE -	FORTRAN, SORTMRG, RECORD MNGR	BNW
C	ESTIMATED RUN FREQUENCY -	ON DEMAND	BNW
C	APPROXIMATE RUN TIME -	20-60 SEC, 70000 CM	BNW
C	PROGRAM DESCRIPTION -	PROCESSES SNOP CODED HISTOPATH DATA	BNW
C		PRINTS GROUP AND SUMMARY REPORTS	BNW
C		WITH ENGLISH EQUIVALENTS OF SNOP CODES	BNW
C		OF TUMORS	BNW
C	MAIN CALCULATIONS -	COUNTS, REPORT GENERATION	BNW
C	INPUT ORIGINATES FROM -	FILES CREATED BY SNOPI PROGRAM	BNW
C	TAPES REQUIRED -	NONE	BNW
C	FILES REQUIRED -	PROGRAMS LIB769, ID=BNW331	BNW
C		DICTIONRY SNOPCODE, ID=BNW331	BNW
C		DATA IDNTNEW, IDNTXXX, ID=BNW331,	BNW
C		DATA TUMRNEW, TUMRXXX, ID=BNW331,	BNW
C	FILES TO BE CATALOGED -	NONE	BNW
C	OUTPUT -	LINE PRINTER (USUALLY 2 PART SMALL)	BNW
C	DELIVER OUTPUT TO -	PATHOLOGIST DEMANDING REPORT	BNW
C	-----	DECK SETUP	BNW
C	-----		BNW
C	GROUP PARAMETER CARD		BNW
C			BNW
C	6/7/8/9 END-OF-JOB-CARD		BNW
C	-----		BNW

FIGURE 32. SNOP4 Program Abstract

SNOP5/SNOP6

These two programs are run concurrently to perform temporary editing of SNOPXXX or TUMRXXX files (Figure 33). SNOP5 modifies topography codes according to a user define set of code equivalents (see page 12). The resulting file is sorted by SORTMRG and utilized by SNOP6 to change diagnosis codes (morphology, etiology or function). This file is sorted and cataloged as SNAPXXX or TAMRXXX and submitted to SNOP2, SNOP3 or SNOP4 to generate the appropriate reports. The only reason to have two programs is to allow the external sorting between the two parts. The flowchart is present in Figures 34 and 35 and the program abstracts in Figures 36 and 37.

SNOP5 reads the dictionary of code equivalents and creates an array of words with the first five characters representing the existing code and the rightmost five characters being the code that will be used as the replacement. After the entire dictionary is created, it is sorted into the same order as the input file (SNOPXXX or TUMRXXX) for processing. If a two digit topography code is entered, then a match on two digits is adequate to cause a replacement. Also if "DROP" is entered for the replacement code, the matching lesions will be dropped from the new file.

Diagnosis changes are read by SNOP5 but are written to mass storage to be used by SNOP6. An optional field is included to indicate a topography qualifier, i.e. one may want to modify inflammatory changes to a common lesion code only if they occurred in the lung.

As more experience is gained with the SNOP codes, we may be able to develop a standard dictionary defining equivalent codes. However, we

FIGURE 33. SNOP5/SNOP6 Run Diagram

SNOP 5

FIGURE 34. SNOP5 Flowchart

SNOP6

FIGURE 35. SNOP6 Flowchart

```

C-----BNW
C          ----- BATTELLE NORTHWEST -----BNW
C          ----- SYSTEMS DEPARTMENT -----BNW
C          ----- STATISTICS SECTION -----BNW
C          ----- BIOMETRICS OPERATION -----BNW
C-----BNW
C          ----- PROGRAM ABSTRACT -----BNW
C          PROGRAM NAME - S N O P 5BNW
C          ORIGINAL PROGRAMER - DICK OLSON / CHUCK WATSONBNW
C          DATE WRITTEN - JULY 1974BNW
C          PROGRAM LANGUAGE - FORTRAN, SORTMRG, RECORD MNGRBNW
C          ESTIMATED RUN FREQUENCY - ON DEMANDBNW
C          APPROXIMATE RUN TIME - 20-60 SEC, 70000 CMBNW
C          PROGRAM DESCRIPTION - PROCESSES SNOP CODED HISTOPATH DATABNW
C                                EDITS TOPOGRAPHY CODES REPLACINGBNW
C                                ORIGINAL CODES WITH DEFINED EQUIVALENTSBNW
C          MAIN CALCULATIONS - COUNTS, REPORT GENERATIONBNW
C          INPUT ORIGINATES FROM - FILES CREATED BY SNOP1 PROGRAMBNW
C          TAPES REQUIRED - NONEBNW
C          FILES REQUIRED - PROGRAMS LI8769,ID=BNW331BNW
C                                DATA SNOPNEW,SNOPXXX,ID=BNW331,BNW
C                                LINE PRINTER (USUALLY 2 PART SMALL)BNW
C                                DATA SNAPTOP(TEMPORARYFILE)BNW
C                                DICTIONARY MORCODE(TEMPORARY FILE)BNW
C-----BNW
C          ----- DECK SETUP -----BNW
C          -----BNW
C          DICTIONARY OF SNOP CODE EQUIVALENTSBNW
C          6/7/8/9 END-OF-JOB-CARDBNW
C-----BNW
C          -----BNW
C          FORMAT OF SNOP CODE EQUIVALENTS -BNW
C          COLUMN DESCRIPTIONBNW
C          1 - 5 A5 NEW COMMON SNOP CODE USED TO REPLACE ORIGINAL CODESBNW
C                                IF COL 2-4 IS "DROP", RECORDS WILL BEBNW
C                                DROPPED FROM ALTERED FILEBNW
C                                IF 2 DIGIT CODE ENTERED, PROGRAM WILL CHECKBNW
C                                FOR MATCH ON JUST 2 DIGITSBNW
C          6 - 80 15A5 EQUIVALENT CODES AS EXISTING IN SNOPXXX FILEBNW
C                                IF TOPOGRAPHY CODES, CAN ENTER 15 CODESBNW
C                                IF DIAGNOSIS CODES, ENTER 7 PAIRS OF CODESBNW
C                                FIRST OF PAIR IS M,F,E CODEBNW
C                                SECOND OF PAIR IS OPTIONAL TOPOGRAPHYBNW
C                                CODE USED AS QUALIFIER TO CHANGESBNW
C          END OF JOB INDICATOR - 7/8/9 END OF FILE AFTER DICTIONARYBNW
C-----BNW

```

FIGURE 36. SNOP5 Program Abstract

```

C-----BNW
C          BATTLE NORTHWEST -----BNW
C          SYSTEMS DEPARTMENT -----BNW
C          STATISTICS SECTION -----BNW
C          BIOMETRICS OPERATION -----BNW
C-----BNW
C          PROGRAM ABSTRACT -----BNW
C  PROGRAM NAME - S N O P 6 BNW
C  ORIGINAL PROGRAMER - DICK OLSON / CHUCK WATSON BNW
C  DATE WRITTEN - JULY 1974 BNW
C  PROGRAM LANGUAGE - FORTRAN, SORTMRG, RECORD MNGR BNW
C  ESTIMATED RUN FREQUENCY - ON DEMAND BNW
C  APPROXIMATE RUN TIME - 20-60 SEC, 70000 CM BNW
C  PROGRAM DESCRIPTION - PROCESSES SNOB CODED HISTOPATH DATA BNW
C                               EDITS MORPHOLOGY, ETIOLOGY + FUNCTION BNW
C                               CODES BY REPLACING THE BNW
C                               ORIGINAL CODES WITH DEFINED EQUIVALENTSBNW
C  MAIN CALCULATIONS - COUNTS, REPORT GENERATION BNW
C  INPUT ORIGINATES FROM - FILES CREATED BY SNOB5 PROGRAM BNW
C  TAPES REQUIRED - NONE BNW
C  FILES REQUIRED - PROGRAMS LIB769, ID=BNW331 BNW
C                               DATA SNAPMOR(FROM SNOB5) BNW
C                               DICTIONARY SRTCODE(FROM SNOB5) BNW
C  OUTPUT - LINE PRINTER (USUALLY 2 PART SMALL) BNW
C                               DATA SNAPSRT, SNAPXXX, ID=BNW331 BNW
C-----BNW
C          DECK SETUP -----BNW
C          SEE SNOB5 AS THESE PROGRAMS NORMALLY ARE RUN SIMULTANEOUSLY BNW
C-----BNW

```

FIGURE 37. SNOB6 Program Abstract

currently anticipate that these modified files will be purged after the reports have been produced so that the original SNOPXXX and TUMRXXX will be considered the prime data base.

ACKNOWLEDGMENTS

The sample data shown in Figures 7 to 15 was obtained as part of a study conducted by Dr. J. E. Ballou. Dr. G. E. Dagle performed the SNOP coding of these observations and contributed many suggestions to increase the usefulness of the SNOP System. The authors appreciate the assistance of Pauline Aldridge, who drew the various run diagrams and flowcharts, and that of Sally Owzarski, who assisted in the final compilation of the report.

APPENDIX A

A complete FORTRAN listing of the SNOP programs and some example output are contained on this microfiche.

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