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A COMPUTER BASED SYSTEM FOR COLLECTION, STORAGE, RETRIEVAL AND REPORTING ACCESSION INFORMATION IN A VETERINARY MEDICAL DIAGNOSTIC LABORATORY

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Abstract—Substantial data collected from large numbers of accessions, the need for comprehensive reporting of negative as well as positive laboratory findings, and the necessity for obtaining rapid diagnostic correlations prompted the development of a computer based system of accession data management for collection, storage, rapid retrieval, reporting, concording, and administrative compiling in a state-university Veterinary Medical Diagnostic Laboratory.

Veterinary medicine Diagnostic laboratory Medical records Accumulating Recalling

INTRODUCTION

Increasing numbers of accessions and a desire to store and rapidly retrieve information on each accession have prompted veterinary hospitals, clinics and diagnostic laboratories to develop computer-based data management systems [1]. One such system has been developed at the University of Missouri-Columbia Research Animal Diagnostic and Investigative Laboratory (RADIL) section of the Veterinary Medical Diagnostic Laboratory at the University of Missouri College of Veterinary Medicine.

Annually, a large amount of accession data is generated at the RADIL. In 1982, for example, there were 1293 accessions with a total of 14,803 animals examined at the RADIL. The development of a computer based system of data management has made the storage, compilation, and rapid retrieval of large amounts of diagnostic information possible. This system is capable of handling large volumes of diagnostic data such as results of histopathology, serology, toxicology, virology, parasitology, necropsy, and microbiology examinations as well as demographic–zoographic/patient data. This system uses the full screen capabilities of IBM 3278 series computer terminals to display a blank panel (essentially a blank form for recording laboratory results) which is filled in by the laboratory technicians at the major data generating stations throughout the laboratory. Preliminary, final, and supplemental reports or select diagnostic data for each accession are printed by the computer directly from this information, and copies of these reports are sent to the person(s) responsible for submitting the accession. Individual accession records are kept in a VSAM database (IBM program product) and archived to magnetic tape every quarter. Information from these records is abstracted by the computer for an annual concordance catalogue index and other administrative reports.

During the development of our data storage and retrieval system, several design objectives were conceived and followed. These included:

1. The system should be easy to use, and require little training;
2. The system should allow for easy production of summaries and year-end reports, preferably using an existing file processing package such as Mark IV (Informatics, Inc.);
3. The system should allow for easy update of accession records;
4. The system should interface with the existing concordance index program [2];
5. There should be little or no keypunching or other data entry required to produce an

annual or other compiled concordance indexes. Data for compiled reports should be acquired passively from existing files originally created to store laboratory data for reporting purposes;

6. Preliminary, supplemental and final reports should be produced in English (as opposed to numerical codes), and in letter format suitable for mailing to commercial research animal producers, investigators and/or owners, and referring veterinarians.

DATA ENTRY

The data entry system described herein requires a large capacity computer. This system runs under the time sharing option of the University of Missouri's Amdahl 470 V/8 running IBM MVS/SP release 3 and JES2/NJE release 3.1 operating systems. Data entry and editing is by means of seven IBM 3278 model 2 full screen computer terminals and one full screen 3276 controller-terminal. These are located in major data-generating areas of the RADIL, i.e. the accessioning area, the necropsy, microbiology, and serology laboratories.

The full screen capabilities of these terminals are used for accessioning and data entry. The computer displays a blank form (panel) on which the CRT terminal operator enters appropriate data. To avoid confusion, the panel is displayed in low intensity characters while operator entries are displayed in high intensity characters. During subsequent screen display of data and for updating accessions, the CRT displays the panel with such information filled in as is currently present in the accession record. The operator may then change or delete this information by typing "over" it, or may add more information to it, or both. Each panel has its own designated "free text" area for continuation of selected fields as well as general comments.

A set of 13 panels are in use, with provisions for adding more panels when needed. Typically, each panel, except the demographic–zoographic and summary–concordance panels, comprises a report of data from one section of the laboratory. Each panel type is shown in this paper with data entered in italics from a fictional accession (No. 12345). The actual report generated and printed from entered data is also presented for each panel. Because all laboratory findings are treated as confidential information, data entries on these panels do not represent actual accession material, but are merely for demonstration purposes.

Demographic–zoographic panel (Fig. 1)

When an accession is presented to the RADIL section of the Veterinary Medical

```
1 @UMC VETERINARY DIAGNOSTIC LABORATORY DEMOGRAPHIC DATA PANEL
2 @CASE #¢      @DATE¢      @RECEIVING LAB CODE¢  @SPEC CODE¬
3 @OWNER INFO: O/I¬ @SOURCE¬
4 @ NAME¬                          @ADDRESS¬
5 @ CITY¬                       @STATE¬  @ZIP¢      @COUNTY¬                    @
6 @ REPORTS TO OWNER: PRELIM¬ @FINAL¬ @PHONE¬ @PHONE #¢          @
7 @BILL: OWNER¬ @REFER¬                                                ¢    @
8 @REFERRER INFO:      @DELIVERED BY¬                                  @
9 @ NAME¬                          @ADDRESS¬
10 @ CITY¬                      @STATE¬  @ZIP¢      @ANIMAL ZIP¢      @
11 @ REPORTS TO REFER: PRELIM¬ @FINAL¬ @PHONE¬ @PHONE #¢          @
12 @NONANI SPECIMEN:¬                                                  @#¢
13 @SPECIES¬                    @STRAIN¬                        @# GROUP¢       @
14 @ #LIVE¢  @AGE¬     @SEX¬  @#LIVE¢  @AGE¬     @SEX¬  @#LIVE¢  @AGE¬     @SEX¬  @
15 @ #DEAD¢  @AGE¬     @SEX¬  @#DEAD¢  @AGE¬     @SEX¬  @#DEAD¢  @AGE¬     @SEX¬  @
16 @ANI ID:¬                    @RM¬    @CG¬       @PRJ¬       @R¬ @C-F¬ @PL¬ @
17 @FOUND DEAD¬ @DATE OF DEATH¢      @TIME¬      @EUTHANIZED¬ @HOW¬
18 @SUPPLIER:¬                                    @BLDG¬      @AR¬    @RM¬
19 @CG¬       @PRJ¬       @CML¬ @PND¬ @WLD¬ @RSD¬ @UNKN¬ @  SHIP¢      @RECD¢
20 @DISEASE DURATION¬           @MORBIDITY¬             @MORTALITY¬             @
21 @RECENT TRMT-VAC¬
22                                  @AB TRMT¬   ¬   ¬   ¬   @ORAL¬ @PAREN¬
23 @DIET¬
24 @HOUSING¬
```

Fig. 1. Demographic–zoographic panel, blank.

```
 1  UMC VETERINARY DIAGNOSTIC LABORATORY DEMOGRAPHIC DATA PANEL
 2  CASE # 123456 DATE 021583 RECEIVING LAB CODE 10 SPEC CODE N
 3  OWNER INFO: O/I I SOURCE UMC LABORATORY ANIMAL MEDICINE
 4   NAME MCLAUGHLIN, R.                    ADDRESS M154 MEDICAL CENTER
 5   CITY COLUMBIA                  STATE MO ZIP 65212 COUNTY
 6   REPORTS TO OWNER: PRELIM X FINAL X PHONE X PHONE # 8821234
 7  BILL: OWNER X REFER
 8  REFERRER INFO:        DELIVERED BY PHYLLIS MITCHELL
 9   NAME WAGNER, J. E.                     ADDRESS VETERINARY MEDICAL DIAGNOSTIC LAB
10   CITY COLUMBIA                  STATE MO ZIP 65211 ANIMAL ZIP
11   REPORTS TO REFER: PRELIM X FINAL X PHONE X PHONE # 8825678
12  NONANI SPECIMEN:                                                        #
13  SPECIES MOUSE                  STRAIN DBA/2NCRL              # GROUP 200
14   #LIVE 10 AGE AD     SEX F  #LIVE 10 AGE JV     SEX M  #LIVE     AGE        SEX
15   #DEAD     AGE       SEX    #DEAD     AGE       SEX    #DEAD     AGE        SEX
16  ANI ID: A-J=FEMALES; K-T=MALES    RM       CG          PRJ P-12345 R X C-F    PL
17  FOUND DEAD    DATE OF DEATH         TIME         EUTHANIZED    HOW
18  SUPPLIER: RAISED-UMC PATHOLOGY                          BLDG         AR       RM
19  CG          PRJ          CML    PND    WLD    RSD X UNKN      SHIP         RECD
20  DISEASE DURATION 2 WEEKS        MORBIDITY 57 OF 200      MORTALITY 0
21  RECENT TRMT-VAC
22                                          AB TRMT                    ORAL    PAREN
23  DIET PURINA CHOW
24  HOUSING PLASTIC SHOE BOX CAGE WITH WOOD SHAVINGS
```

Fig. 1(a). Demographic–zoographic panel, completed.

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                    FINAL REPORT OF LABORATORY EXAMINATION
                                 FROM THE
            RESEARCH ANIMAL DIAGNOSTIC AND INVESTIGATIVE LABORATORY
                        COLLEGE OF VETERINARY MEDICINE
                UNIVERSITY OF MISSOURI, COLUMBIA, MISSOURI 65211

ACCESSION NUMBER: 123456-83                 RECEIVED ON: FEBRUARY 15, 1983
SPECIMEN: ANIMAL(S) FOR NECROPSY            DELIVERED BY: PHYLLIS MITCHELL

INVESTIGATOR:                               PHONE: 882-1234

     MCLAUGHLIN, R.
     UMC LABORATORY ANIMAL MEDICINE
     M154 MEDICAL CENTER
     COLUMBIA, MO  65212

REFERRING VETERINARIAN:                     PHONE: 882-5678

     WAGNER, J. E.
     VETERINARY MEDICAL DIAGNOSTIC LAB
     COLUMBIA, MO  65211

ANIMAL INFORMATION:

    SPECIES: MOUSE                         STRAIN: DBA/2NCRL
     NUMBER LIVE: 10  AGE: ADULT            SEX: FEMALE
     NUMBER LIVE: 10  AGE: JUVENILE         SEX: MALE
     TOTAL NUMBER PRESENTED: 20             NUMBER AT RISK: 200
     ANIMAL IDENTIFICATION: A-J=FEMALES; K-T=MALES
     PROJECT: P-12345                       ANIMAL USE: RESEARCH

SUPPLIER INFORMATION:

     SUPPLIER: RAISED-UMC PATHOLOGY

CASE HISTORY:

     DISEASE DURATION: 2 WEEKS
     MORBIDITY: 57 OF 200                   MORTALITY: 0
     DIET: PURINA CHOW
     HOUSING: PLASTIC SHOE BOX CAGE WITH WOOD SHAVINGS

GENERAL COMMENTS:

     THIS IS A HYPOTHETICAL ACCESSION TO DEMONSTRATE THE UNIVERSITY
     OF MISSOURI RESEARCH ANIMAL DIAGNOSTIC AND INVESTIGATIVE
     LABORATORY DATA ENTRY SYSTEM.
```

Fig. 1(b). Demographic–zoographic panel, final report.

Diagnostic Laboratory, demographic and zoographic information is immediately entered by a data controller or data entry operator from information on a form submitted with the accession. This panel (Fig. 1) includes such information as the investigator's and/or owner's name and address, the referring veterinarian's name and address, type of specimen submitted (whole animal, slides, fixed tissue for histopathology, swabs for culture, etc.), number of specimens submitted, species, strain, age, sex and name of animal (if applicable), and accession history. Owner or investigator, and referrer names may be entered as a 3-digit code number which the computer "looks up" in a directory, replacing the number with the appropriate name and address on all subsequent CRT displays or printed reports. This insures consistency and accuracy in names and addresses.

Figure 1(a) is an example of a typical completed demographic–zoographic panel. Data entered by the data controller appears in italics. The "OWNER INFO" on lines 3–5 and the "REFERRER INFO" on lines 8–10 could have been entered as a 3 digit code number if these names and addresses were in the computer's directory. The panel contains information about 20 mice, submitted for necropsy examination from the UMC (University of Missouri-

```
 1  LAB DATA RESEARCH ANIMAL NECROPSY PANEL
 2            CASE 123456  DATE 021583  # THIS PANEL: 20 OF 20          LABID A - T
 3  PRE NECROPSY OBS: SPECIES MOUSE                    STRAIN DBA/2NCRL
 4   HAIR COLOR GRAY                  ANI ID/MARKINGS
 5   #LIVE 10 AGE AD     SEX F  #LIVE 10 AGE JV     SEX M  #LIVE     AGE        SEX
 6   #DEAD     AGE       SEX    #DEAD     AGE       SEX    #DEAD     AGE        SEX
 7   ANI   WT      ANI   WT     COMBD WT          AVG WT 28   WT OTHER THAN GMS
 8   SER # 10 BLD COLLECT MTHD 1                      ANES AGT NEMBUTAL
 9   EUTH MTHD CO2                          BODY OPEN EXUDATE AROUND THE |A|      # 2
10   GEN APPEAR 1                          #    SKEL PALP 1                      #
11   HAIR COAT COND ROUGH HAIR COAT        # 6  EXT LESIONS 1                    #
12
13  GROSS NECROPSY OBS: NGL IN ANY SYSTEM  DEGREE PMD NONE      BODY FAT ADEQUATE
14  SKIN N     EYES N    TYMP BULL M|B| THOR CAV       LUNGS H     TRACHEA M
15  NASOPHAR M     UP RES REG       HEART N     VESSELS N     SAL GLD H
16  ABDOM CAV       STOM H     DUO H     JEJ N      ILEUM        CEC M    COL N
17  LIV H     GUTROLL H    PAN N     KID N     ADREN N     SPLEEN H     UR TRACT
18  GEN ORG       REPRO TRAC |E|  SUBMAN       L NODES       BRAIN N      PIT
19  SP CORD       BONE MAR        MUSCULATURE       SKELETON
20  OTHER
21  PARASITE CHECK X
22  TENTATIVE NECROPSY DIAGNOSIS:
23
24                  PROS W. J. WARRINER        PATH J. E. WAGNER
```

Fig. 2. Necropsy panel, completed.

```
 1                              FREE TEXT PANEL
 2  |*|FECAL SPECIMENS WERE TAKEN FROM THE COLON OF EACH ANIMAL FOR SALMONELLA AND P
 3  SEUDOMONAS CULTURE. SEROLOGY DONE ON FEMALES ONLY.|A|EYES.|B|PURULENT EXUDATE -
 4  ANIMALS A, D, E, G, AND T.|E|ANIMALS H AND J WERE PREGNANT.
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Fig. 2(a). Necropsy panel, free text panel.

Columbia) Laboratory Animal Medicine Department. Figure 1(b) is a copy of the final report generated from this panel.

The demographic–zoographic panel (Fig. 1) and summary–concordance panel (Fig. 13) always occur exactly once per accession, and together with certain control information, form the "base segment" of the accession. In addition to the base segment, for each accession, there are several types of "subordinate segments" which may occur independently of each other any number of times, or not at all. Each subordinate segment is represented by a panel type, as described herein.

Necropsy panel (Fig. 2)

The necropsy results panel (Fig. 2) includes space for recording results of prenecropsy and necropsy examinations for one or more animals. Figure 2 includes data entries for 20 animals; 10 adult females and 10 juvenile males (arrow, line 5). Reports of negative findings and normal necropsy observations, as well as reports of the kinds of techniques used (such as

```
                    REPORT OF NECROPSY EXAMINATION

THIS REPORT COVERS 20 ANIMAL(S) NECROPSIED UNDER ACCESSION NUMBER 123456-83
ON FEBRUARY 15, 1983.  THE SUBJECTS OF THIS ACCESSION WERE IDENTIFIED AS:

     SPECIES: MOUSE              STRAIN: DBA/2NCRL              LAB ID: A-T
     COLOR: GRAY

PRE-NECROPSY EXAMINATION REVEALED:

     NUMBER LIVE: 10  AGE: ADULT       SEX: FEMALE
     NUMBER LIVE: 10  AGE: JUVENILE    SEX: MALE
     AVERAGE WEIGHT: 28 GRAMS
     GENERAL APPEARANCE: THE GENERAL APPEARANCE WAS NORMAL FOR
     ANIMALS OF THIS SPECIES, AGE, AND SEX.
     HAIR CONDITION: ROUGH HAIR COAT  (6  OF 20 ANIMALS)
     SKELETAL PALPATIONS: SKELETAL PALPATION REVEALED A NORMAL
     AXIOSKELETON.
   ►BODY OPENINGS: EXUDATE AROUND THE EYES.  (2  OF 20 ANIMALS)
     OTHER EXTERNAL ABNORMALITIES: NO OTHER EXTERNAL ABNORMALITIES OR
     LESIONS WERE NOTED.
     ANESTHETIC AGENT: NEMBUTAL
     EUTHANASIA METHOD: CO2

GROSS NECROPSY OBSERVATIONS:

     DEGREE OF POST MORTEM DECOMPOSITION: NONE
     AMOUNT OF BODY FAT: ADEQUATE

     TYMPANIC BULLA: PURULENT EXUDATE - ANIMALS A, D, E, G, AND T.
     REPRODUCTIVE TRACT: ANIMALS H AND J WERE PREGNANT.

     NO SIGNIFICANT GROSS LESIONS WERE OBSERVED IN THE FOLLOWING
     ORGANS: SKIN, EYES, LUNGS, TRACHEA, NASOPHARYNX, HEART, VESSELS,
     SALIVARY GLANDS, STOMACH, DUODENUM, JEJUNUM, CECUM, COLON,
     LIVER, GUT ROLL, PANCREAS, KIDNEYS, ADRENAL GLANDS, SPLEEN,
     BRAIN.

ADDITIONAL EXAMINATIONS:

     SPECIMENS FROM THE FOLLOWING ORGANS WERE COLLECTED FOR
     MICROBIOLOGICAL EXAMINATION: TYMPANIC BULLA, TRACHEA,
     NASOPHARYNX, CECUM.

     PORTIONS OF THE FOLLOWING ORGANS WERE PRESERVED FOR
     HISTOPATHOLOGICAL EXAMINATION: LUNGS, SALIVARY GLANDS, STOMACH,
     DUODENUM, LIVER, GUT ROLL, SPLEEN.

     SPECIMENS WERE COLLECTED FOR PARASITOLOGICAL EXAMINATION.

     SERUM SAMPLES FOR VIRUS ANTIBODY DETERMINATION WERE COLLECTED
     FROM 10 OF 20 ANIMALS. BLOOD COLLECTION METHOD - JUGULAR
     INCISION.

GENERAL COMMENTS:

     FECAL SPECIMENS WERE TAKEN FROM THE COLON OF EACH ANIMAL FOR
     SALMONELLA AND PSEUDOMONAS CULTURE. SEROLOGY DONE ON FEMALES
     ONLY.

PROSECTOR: W. J. WARRINER              PATHOLOGIST: J. E. WAGNER
```

Fig. 2(b). Necropsy panel, final report.

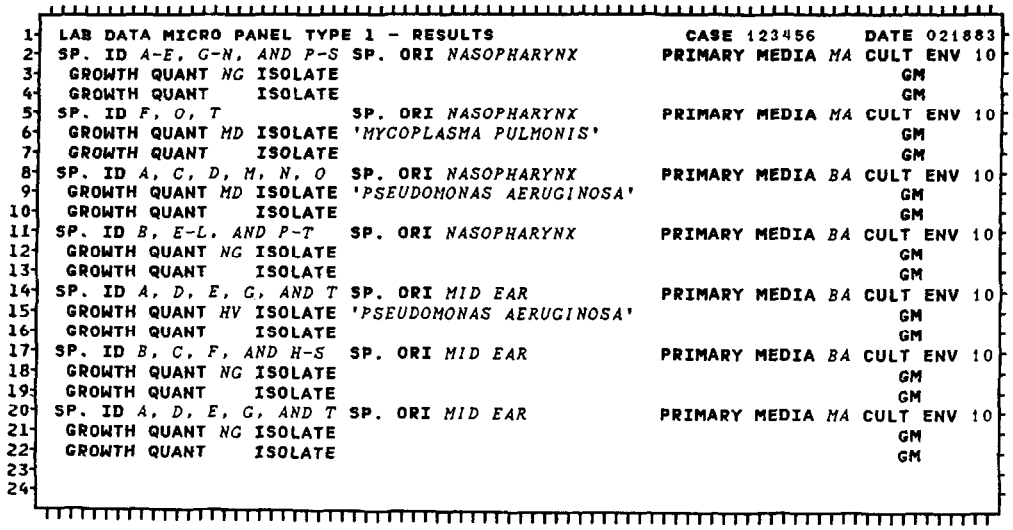

Fig. 3. Microbiology panel type 1, completed.

REPORT OF MICROBIOLOGICAL EXAMINATION

ACCESSION NUMBER: 123456-83 DATE: FEBRUARY 18, 1983

ANIMAL OR SPECIMEN IDENTIFICATION: A-E, G-N, AND P-S

SPECIMEN ORIGIN: NASOPHARYNX
CULTURE MEDIA: ARGININE BASED MYCOPLASMA MEDIA
CULTURE ENVIRONMENT: IN 10% CO2 AT 37° C. HUMIDIFIED AIR
RESULT: NO GROWTH

ANIMAL OR SPECIMEN IDENTIFICATION: F, O, T

SPECIMEN ORIGIN: NASOPHARYNX
CULTURE MEDIA: ARGININE BASED MYCOPLASMA MEDIA
CULTURE ENVIRONMENT: IN 10% CO2 AT 37° C. HUMIDIFIED AIR
ISOLATE: *MYCOPLASMA PULMONIS* - MODERATE GROWTH

ANIMAL OR SPECIMEN IDENTIFICATION: A, C, D, M, N, O

SPECIMEN ORIGIN: NASOPHARYNX
CULTURE MEDIA: BLOOD AGAR
CULTURE ENVIRONMENT: IN 10% CO2 AT 37° C. HUMIDIFIED AIR
ISOLATE: *PSEUDOMONAS AERUGINOSA* - MODERATE GROWTH

ANIMAL OR SPECIMEN IDENTIFICATION: B, E-L, AND P-T

SPECIMEN ORIGIN: NASOPHARYNX
CULTURE MEDIA: BLOOD AGAR
CULTURE ENVIRONMENT: IN 10% CO2 AT 37° C. HUMIDIFIED AIR
RESULT: NO GROWTH

ANIMAL OR SPECIMEN IDENTIFICATION: A, D, E, G, AND T

SPECIMEN ORIGIN: MID EAR
CULTURE MEDIA: BLOOD AGAR
CULTURE ENVIRONMENT: IN 10% CO2 AT 37° C. HUMIDIFIED AIR
ISOLATE: *PSEUDOMONAS AERUGINOSA* - HEAVY GROWTH

ANIMAL OR SPECIMEN IDENTIFICATION: B, C, F, AND H-S

SPECIMEN ORIGIN: MID EAR
CULTURE MEDIA: BLOOD AGAR
CULTURE ENVIRONMENT: IN 10% CO2 AT 37° C. HUMIDIFIED AIR
RESULT: NO GROWTH

ANIMAL OR SPECIMEN IDENTIFICATION: A, D, E, G, AND T

SPECIMEN ORIGIN: MID EAR
CULTURE MEDIA: ARGININE BASED MYCOPLASMA MEDIA
CULTURE ENVIRONMENT: IN 10% CO2 AT 37° C. HUMIDIFIED AIR
RESULT: NO GROWTH

Fig. 3(a). Microbiology panel type 1, final report.

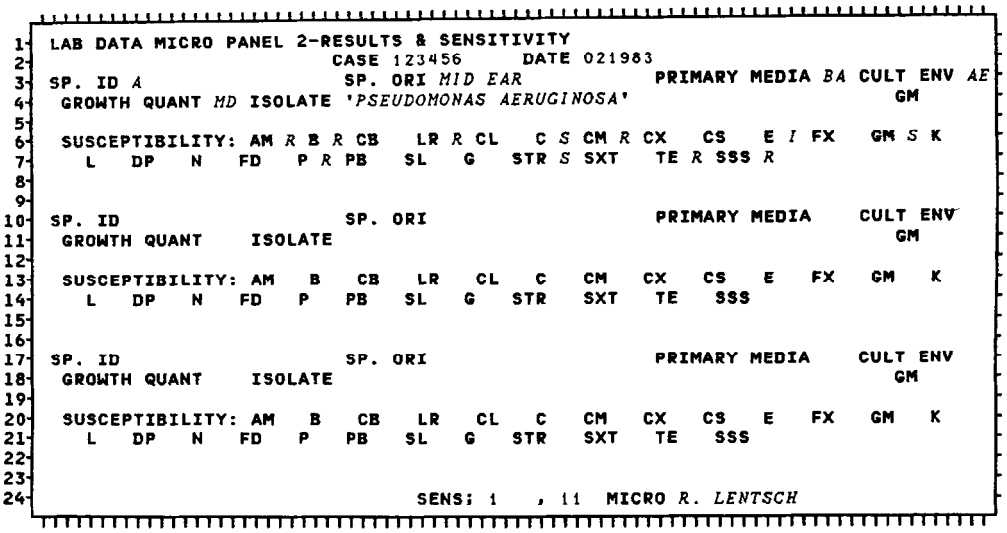

Fig. 4. Microbiology panel type 2, completed.

REPORT OF MICROBIOLOGICAL EXAMINATION

ACCESSION NUMBER: 123456-83 DATE: FEBRUARY 19, 1983

ANIMAL OR SPECIMEN IDENTIFICATION: A

SPECIMEN ORIGIN: MID EAR
CULTURE MEDIA: BLOOD AGAR
CULTURE ENVIRONMENT: AEROBICALLY AT 37° C.
ISOLATE: *PSEUDOMONAS AERUGINOSA* - MODERATE GROWTH

RESULTS OF ANTIBIOTIC EXAMINATIONS:

THE ISOLATE WAS SUSCEPTIBLE TO: CHLORAMPHENICOL, GENTAMYCIN, STREPTOMYCIN.

THE ISOLATE WAS RESISTANT TO: AMPICILLIN, BACITRACIN, CEPAHLORIDINE, CLINDAMYCIN, PENICILLIN G, TETRACYCLINE, SULFONAMIDES.

THE ISOLATE WAS INTERMEDIATE IN SUSCEPTIBILITY TO: ERYTHROMYCIN.

MICROBIOLOGIST: R. LENTSCH

Fig. 4(a). Microbiology panel type 2, final report.

the kind of blood collection method used, arrow, Fig. 2, line 8) can be entered by a code number, thus reducing data entry time. Through use of a directory, the code number appears as a statement in English when printed on the report. If the data entry operator needs more space than is available on the panel to enter or report a finding, a free text reference can be entered in the appropriate field, eg. the "| A |" at the arrow on line 9 in Fig. 2. This allows the operator to continue the report of a finding in a free text area (eg. "| A | EYES." in Fig. 2(a) on line 3). The computer will, on the final printed report, replace the free text reference with the text from the free text area (arrow on Fig. 2(b)).

Organs and tissues can be designated as normal (N) and/or "flagged" as having been sent to either the histopathology (H) or microbiology (M) laboratory subsections, or both (X) (arrows in Fig. 2 on lines 14–19).

In Fig. 2, line 8, a code number was entered to indicate the method of blood collection used; "1" (arrow) when taken from the directory and printed on the report reads, "JUGULAR INCISION". An entry of "2" would read, "ORBITAL BLEEDING", and "3" would read, "AXILLARY INCISION". Code numbers are also used for several other entries,

```
 1  LAB DATA MICROBIOLOGY PANEL 3
 2                    CASE 123456   DATE 021883
 3  SPECIMEN ORIGIN TRACHEA
 4  BACTERIA              A   B   C   D   E   K   L   M   N   O
 5    ACTINOBACILLUS SP   -   -   -   -   -   -   -   -   -   -
 6    BORD. BRONCHISEPTICA -  -   -   -   -   -   -   -   -   -
 7  X CITROBACTER FREUNDII -  -   -   -   -   -   -   -   -   -
 8    CORYNEB. KUTSCHERII -   -   -   -   -   -   -   -   -   -
 9    E. COLI             -   -   -   -   -   -   -   -   -   -
10    ENTEROBACTER SP     -   -   -   -   -   -   -   -   -   -
11    KLEB. PNEUMONIAE    -   -   -   -   -   -   -   -   -   -
12    MYCOPLASMA PULMONIS +1  +1  +2  +2  -   -   +1  +2  +2  +1
13  X PAST. PNEUMOTROPICA -   -   -   -   -   -   -   -   -   -
14    PSEUDOM. AERUGINOSA +2  -   +3  +2  -   -   -   +3  +1  +1
15    PROTEUS SP          -   +1  -   -   -   -   -   +1  -   -
16    SALMONELLA SP       -   -   -   -   -   -   -   -   -   -
17    STAPH. AUREUS       +3  +3  -   +2  +1  +2  -   +3  +1  +1
18    STAPH. EPIDERMIDIS  -   -   -   -   -   -   -   -   -   -
19    STREPT. MONILIFORMIS -  -   -   -   -   -   -   -   -   -
20    STREPT. PNEUMONIAE  -   -   -   -   -   -   -   -   -   -
21    ALPHA HEM STREPT. SP -  -   -   -   -   -   -   -   -   -
22  X                     -   -   -   -   -   -   -   -   -   -
23  X                     -   -   -   -   -   -   -   -   -   -
24                    MICRO R. LENTSCH
```

Fig. 5. Microbiology panel type 3, completed.

REPORT OF MICROBIOLOGICAL EXAMINATION

ACCESSION NUMBER: 123456-83 DATE: FEBRUARY 18, 1983

SPECIMEN ORIGIN: TRACHEA

BACTERIA	ANIMAL IDENTIFICATION A	B	C	D	E	K	L	M	N	O
ACTINOBACILLUS SP.	-	-	-	-	-	-	-	-	-	-
BORDETELLA BRONCHISEPTICA	-	-	-	-	-	-	-	-	-	-
CORYNEBACTERIUM KUTSCHERII	-	-	-	-	-	-	-	-	-	-
E. COLI	-	-	-	-	-	-	-	-	-	-
ENTEROBACTER SP.	-	-	-	-	-	-	-	-	-	-
KLEBSIELLA PNEUMONIAE	-	-	-	-	-	-	-	-	-	-
MYCOPLASMA PULMONIS	+1	+1	+2	+2	-	-	+1	+2	+2	+1
PSEUDOMONAS AERUGINOSA	+2	-	+3	+2	-	-	-	+3	+1	+1
PROTEUS SP.	-	+1	-	-	-	-	-	+1	-	-
SALMONELLA SP.	-	-	-	-	-	-	-	-	-	-
STAPHYLOCOCCUS AUREUS	+3	+3	-	+2	+1	+2	-	+3	+1	+1
STAPHYLOCOCCUS EPIDERMIDIS	-	-	-	-	-	-	-	-	-	-
STREPTOBACILLUS MONILIFORMIS	-	-	-	-	-	-	-	-	-	-
STREPTOCOCCUS PNEUMONIAE	-	-	-	-	-	-	-	-	-	-
ALPHA HEMOLYTIC *STREPTOCOCCUS* SP.	-	-	-	-	-	-	-	-	-	-

LEGEND:

+ = AGENT RECOVERED
- = AGENT NOT RECOVERED
blank = NO ATTEMPT TO CULTURE

1 = SLIGHT GROWTH
2 = MODERATE GROWTH
3 = HEAVY GROWTH

MICROBIOLOGIST: R. LENTSCH

Fig. 5(a). Microbiology panel type 3, final report.

such as general appearance (line 10), skeletal palpation (line 10), and external lesions (line 11). Through use of a directory these code numbers are replaced by "canned" statements on the final report (Fig. 2(b)).

If these animals were without significant gross lesions, a code number would have been entered in the field "NGL IN ANY SYSTEM" (arrow in Fig. 2 on line 13). Depending on which code number was used, the final report would contain a statement telling which organs and tissues had been examined and found without lesions.

Microbiology panels (Figs 3–7)

There are five different panel formats for entering microbiology results. The first is

designed to show detailed microbiological culture results from individual organs or sites (Fig. 3). Shown in Fig. 3 and 3(a) are typical culture results for a group of animals in which nasopharynx and middle ear were cultured on mycoplasma agar and on blood agar and incubated in a 10% carbon dioxide environment.

The second format for entering microbiology results shows the results of antimicrobial sensitivity testing (Fig. 4). In this accession, an antibiotic sensitivity test was performed on a *Pseudomonas aeruginosa* bacterial isolant from the middle ear of animal A, and its relative sensitivity to 11 antibiotics was determined (Figs 4 and 4(a)).

The third format reports microbiology results in a tabular form (Fig. 5). The bacterial isolants commonly cultured from laboratory rodents are listed on the panel and there is room for adding two additional isolants on the same table. In the event that culture methods employed would not detect certain microorganisms, an "X" placed in the space immediately preceding the genus and species of the bacteria causes elimination of that line (organism) from the final report (Fig. 5, lines 7 and 13). Thus *Citrobacter freundii* and *Pasteurella pneumotropica* do not appear on the final report (Fig. 5(a)). Negative results are filled in automatically by the computer, and are overtyped if positive results are found.

```
1  LAB DATA MICROBIOLOGY PANEL 4
2                          CASE 123456   DATE 021883
3  SPECIMEN ORIGIN CECUM
4  BACTERIA                A   B   C   D   E   K   L   M   N   O
5     'ACTINOBACILLUS' SP. -   -   -   -   -   -   -   -   -   -
6     'BORDETELLA BRONC|A| -   -   -   -   -   -   -   -   -   -
7     'CITROBACTER FREU|B| -   +1  +2  -   -   +1  +1  -   +1  +3
8     'E. COLI'           +1  +1  +2  +3  +2  +2  +3  +3  +1  +1
9     'ENTEROBACTER' SP.  +1  -   -   +1  -   -   -   +2  -   -
10    'KLEBSIELLA' SP.    -   -   -   -   -   -   -   -   -   -
11    'PSEUDOMONAS AERU|C| -   -   -   -   -   -   -   -   -   -
12    'PROTEUS' SP.       -   -   -   -   +1  -   -   -   -   -
13    'SALMONELLA' SP.    -   -   -   -   -   -   -   -   -   -
14    'PASTEURELLA PNEU|D| -   -   -   -   -   -   -   -   -   -
15
16
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22
23
24                          MICRO R. LENTSCH
```

Fig. 6. Microbiology panel type 4, completed.

```
1                          FREE TEXT PANEL
2  |*|THE 'CITROBACTER FREUNDII' CULTURED WAS A NON PATHOGENIC BIOTYPE.|A|HISEPTICA
3  'IB|NDII'|C|GINOSA'|D|MOTROPICA'
4
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Fig. 6(a). Microbiology panel type 4, free text panel.

REPORT OF MICROBIOLOGICAL EXAMINATION

ACCESSION NUMBER: 123456-83 DATE: FEBRUARY 18, 1983

SPECIMEN ORIGIN: CECUM

BACTERIA	ANIMAL IDENTIFICATION A	B	C	D	E	K	L	M	N	O
ACTINOBACILLUS SP.	-	-	-	-	-	-	-	-	-	-
BORDETELLA BRONCHISEPTICA	-	-	-	-	-	-	-	-	-	-
CITROBACTER FREUNDII	-	+1	+2	-	-	+1	+1	-	+1	+3
E. COLI	+1	+1	+2	+3	+2	+2	+3	+3	+1	+1
ENTEROBACTER SP.	+1	-	-	+1	-	-	-	+2	-	-
KLEBSIELLA SP.	-	-	-	-	-	-	-	-	-	-
PSEUDOMONAS AERUGINOSA	-	-	-	-	-	-	-	-	-	-
PROTEUS SP.	-	-	-	-	+1	-	-	-	-	-
SALMONELLA SP.	-	-	-	-	-	-	-	-	-	-
PASTEURELLA PNEUMOTROPICA	-	-	-	-	-	-	-	-	-	-

LEGEND:

+ = AGENT RECOVERED
- = AGENT NOT RECOVERED
blank = NO ATTEMPT TO CULTURE

1 = SLIGHT GROWTH
2 = MODERATE GROWTH
3 = HEAVY GROWTH

GENERAL COMMENTS:

THE *CITROBACTER FREUNDII* CULTURED WAS A NON PATHOGENIC BIOTYPE.

MICROBIOLOGIST: R. LENTSCH

Fig. 6(b). Microbiology panel type 4, final report.

The fourth microbiology panel type (Fig. 6) reports group results in a tabular format, but the genus and species of the bacteria must be filled in by the data entry operator (Figs 6, 6(a) and 6(b)).

A specialized form of microbiological examination panel is provided for reporting positive or negative results of tests on large numbers of fecal specimens cultured for *Salmonella spp.* and *Pseudomonas spp.* (Fig. 7). This panel is designed to facilitate tracking of culture results by supplier and colony (building and room). The results shown in Figs 7, 7(a) and 7(b) indicate that the first five samples were negative for both Pseudomonas and Salmonella, the sixth was positive for Pseudomonas and negative for Salmonella, samples 7–15 were

LAB DATA SALMONELLA TEST RESULTS PANEL

CASE 123456 DATE 021883

PRIM GEN CTR RODENT PROD CNTR HYB CONTR BIO TEST X COMML CODE 987

# OF SAMPLES		STRAIN	BLDG	AREA	ROOM	SOURCE	PSEUDOMONAS	SALMONELLA
1	5	*DBA/2NCRL*	*A-1234*	*B-5678*	*90C*	*UMC PATH*	-	-
6		*DBA/2NCRL*	*A-1234*	*B-5678*	*90C*	*UMC PATH*	+	-
7	15	*DBA/2NCRL*	*A-1234*	*B-5678*	*90C*	*UMC PATH*	-	-
16		*DBA/2NCRL*	*A-1234*	*B-5678*	*90D*	*UMC PATH*	+	+
17	20	*DBA/2NCRL*	*A-1234*	*B-5678*	*90D*	*UMC PATH*	+	-

MICRO: *R. LENTSCH*

Fig. 7. Microbiology panel type 5, completed.

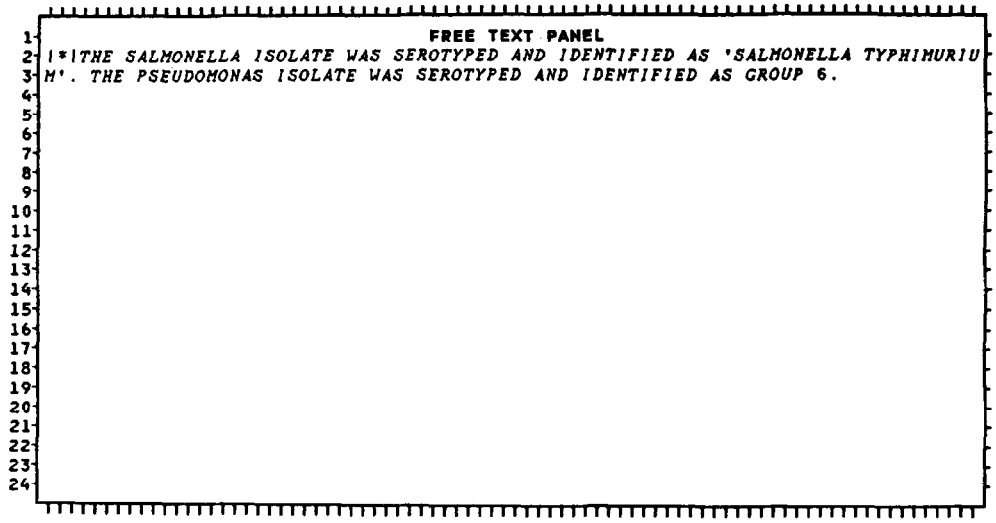

Fig. 7(a). Microbiology panel type 5, free text panel.

RESULTS OF PSEUDOMONAS-SALMONELLA SCREENING EXAMINATIONS

UMC ACCESSION #: 123456-83

RECEIVED ON: FEBRUARY 15, 1983 COMPLETED ON: FEBRUARY 18, 1983
OWNER: MCLAUGHLIN, R. REFERRER: WAGNER, J. E.
SOURCE: UMC LABORATORY ANIMAL MEDICINE
SPECIES: MOUSE CODE: 987
NUMBER SPECIMENS EXAMINED: 20

SAMPLE #	STRAIN	BLDG	AREA	ROOM	ANIMAL ORIGIN	RESULTS PSEUD.	SALMN.
1	DBA/2NCRL	A-1234	B-5678	90C	UMC PATH	-	-
2	DBA/2NCRL	A-1234	B-5678	90C	UMC PATH	-	-
3	DBA/2NCRL	A-1234	B-5678	90C	UMC PATH	-	-
4	DBA/2NCRL	A-1234	B-5678	90C	UMC PATH	-	-
5	DBA/2NCRL	A-1234	B-5678	90C	UMC PATH	-	-
6	DBA/2NCRL	A-1234	B-5678	90C	UMC PATH	+	-
7	DBA/2NCRL	A-1234	B-5678	90C	UMC PATH	-	-
8	DBA/2NCRL	A-1234	B-5678	90C	UMC PATH	-	-
9	DBA/2NCRL	A-1234	B-5678	90C	UMC PATH	-	-
10	DBA/2NCRL	A-1234	B-5678	90C	UMC PATH	-	-
11	DBA/2NCRL	A-1234	B-5678	90C	UMC PATH	-	-
12	DBA/2NCRL	A-1234	B-5678	90C	UMC PATH	-	-
13	DBA/2NCRL	A-1234	B-5678	90C	UMC PATH	-	-
14	DBA/2NCRL	A-1234	B-5678	90C	UMC PATH	-	-
15	DBA/2NCRL	A-1234	B-5678	90C	UMC PATH	-	-
16	DBA/2NCRL	A-1234	B-5678	90D	UMC PATH	+	+
17	DBA/2NCRL	A-1234	B-5678	90D	UMC PATH	+	-
18	DBA/2NCRL	A-1234	B-5678	90D	UMC PATH	+	-
19	DBA/2NCRL	A-1234	B-5678	90D	UMC PATH	+	-
20	DBA/2NCRL	A-1234	B-5678	90D	UMC PATH	+	-

GENERAL COMMENTS:

THE SALMONELLA ISOLATE WAS SEROTYPED AND IDENTIFIED AS *SALMONELLA TYPHIMURIUM*. THE PSEUDOMONAS ISOLATE WAS SEROTYPED AND IDENTIFIED AS GROUP 6.

MICROBIOLOGIST: R. LENTSCH

Fig. 7(b). Microbiology panel type 5, final report.

negative for both, sample 16 was positive for both, and samples 17–20 were positive for Pseudomonas but negative for Salmonella.

Parasitology panel (Fig. 8)

The parasitology panel (Fig. 8) is for recording results of parasitological examinations performed. Both "EXAM METHOD" and "SPECIMEN EXAMINED" may be entered as

```
LAB DATA RESEARCH ANIMAL PARASITOLOGY PANEL
                          CASE 123456   DATE 021583
ANI ID A-T                          SPECIMEN EXAMINED 2
 EXAM METHOD 5
 PARASITE SCI 'RADFORDIA AFFINIS'                                  PARA LD H
ANI ID A-T                          SPECIMEN EXAMINED 1
 EXAM METHOD 6
 PARASITE SCI 'SYPHACIA OBVELATA'                                  PARA LD M
ANI ID A-T                          SPECIMEN EXAMINED 7
 EXAM METHOD EXAMINATION OF CECAL CONTENTS WITH DISSECTING SCOPE
 PARASITE SCI 'SYPHACIA OBVELATA'                                  PARA LD M
ANI ID                              SPECIMEN EXAMINED
 EXAM METHOD
 PARASITE SCI                                                      PARA LD
ANI ID                              SPECIMEN EXAMINED
 EXAM METHOD
 PARASITE SCI                                                      PARA LD
ANI ID                              SPECIMEN EXAMINED
 EXAM METHOD
 PARASITE SCI                                                      PARA LD
ANI ID                              SPECIMEN EXAMINED
 EXAM METHOD
 PARASITE SCI                                                      PARA LD
                                          PARASIT S. V. GIBSON
```

Fig. 8. Parasitology panel, completed.

REPORT OF PARASITOLOGICAL EXAMINATION

ACCESSION NUMBER: 123456-83 DATE: FEBRUARY 15, 1983

ANIMAL(S): A-T

SPECIMEN ORIGIN: PELAGE
EXAMINATION METHOD: EXAMINATION OF PELAGE WITH A DISSECTING MICROSCOPE.
PARASITE: *RADFORDIA AFFINIS* - HEAVY LOAD

ANIMAL(S): A-T

SPECIMEN ORIGIN: PERIANAL AREA
EXAMINATION METHOD: MICROSCOPIC EXAMINATION OF CELLOPHANE TAPE IMPRESSION(S).
PARASITE: *SYPHACIA OBVELATA* - MODERATE LOAD

ANIMAL(S): A-T

SPECIMEN ORIGIN: CECUM
EXAMINATION METHOD: EXAMINATION OF CECAL CONTENTS WITH DISSECTING SCOPE
PARASITE: *SYPHACIA OBVELATA* - MODERATE LOAD

PARASITOLOGIST: S. V. GIBSON

Fig. 8(a). Parasitology panel, final report.

```
LAB DATA RODENT VIRUS SEROLOGY PANEL
                          CASE 123456   DATE 021783

ANI MAD  MHV  LCM  RCV  SENC      KRV  MVM  KVIR POLY PVM  REO3 GD7  H-1  ECTR
A   -    -    -         20             -    -    -    10   -    -
B   -    80   -         10             -    -    -    20   -    -
C   -    10   -         -              -    -    -    -    -    -
D   -    40   -         160            -    -    -    40   -    -
E   -    AC   AC        AC             -    -    -    -    -    -
F   -    20   -         -              -    -    NS   NS   -    -
G   -    -    -         40             INS  INS  -    40   -    -
H   -    -    -         -              -    -    -    -    -    -
I   -    -    -         -              -    -    -    80   -    -
J   -    -    -         40             -    -    -    40   -    -

                                    SEROLOGIST K. O'TOOLE
```

Fig. 9. Serology panel, completed.

REPORT OF SEROLOGICAL EXAMINATION

ACCESSION NUMBER: 123456-83 DATE: FEBRUARY 17, 1983

COMPLEMENT FIXATION TESTS

	MAD	MHV	LCM	RCV	SENDAI
MST:	1:10	1:10	1:10	1:10	1:10
ANIMAL(S)					
A	-	-	-		1:20
B	-	1:80	-		1:10
C	-	1:10	-		-
D	-	1:40	-		1:160
E	-	AC	AC		AC
F	-	1:20	-		-
G	-	-	-		1:40
H	-	-	-		-
I	-	-	-		-
J	-	-	-		1:40

HEMAGGLUTINATION INHIBITION TESTS

	KRV	MVM	KVIRUS	POLY	PVM	REO3	GDVII	H-1	ECTRO
MST:	1:20	1:20	1:10	1:20	1:10	1:20	1:20	1:20	1:20
ANIMAL(S)									
A		-	-	-	1:10	-	-		
B		-	-	-	1:20	-	-		
C		-	-	-	-	-	-		
D		-	-	-	1:40	-	-		
E		-	-	-	-	-	-		
F		-	-	NS	NS	-	-		
G		INS	INS	-	1:40	-	-		
H		-	-	-	-	-	-		
I		-	-	-	1:80	-	-		
J		-	-	-	1:40	-	-		

LEGEND:

MST = MINIMUM SIGNIFICANT TITER
AC = ANTICOMPLEMENTARY
\- = NEGATIVE RESULTS
** = SUSPECT TITER DETECTED
blank = TEST NOT PERFORMED
NS = NON-SPECIFIC HEMAGGLUTINATION
INS = INSUFFICIENT QUANTITY TO TEST

SEROLOGIST: K. O'TOOLE

Fig. 9(a). Serology panel, final report.

either a code number or in English (Fig. 8). On the printed report the code numbers are translated into "canned" responses (Fig. 8(a)). For example, a "SPECIMEN EXAMINED" entry of "1" (arrow in Fig. 8 on line 6) refers to the perianal area (Fig. 8(a)), and an "EXAM METHOD" entry of "6" (arrow in Fig. 8 on line 7) indicates microscopic examination by cellophane tape impressions (Fig. 8(a)).

LAB DATA ELISA RESULTS PANEL
CASE 123456 DATE 021683

ELISA PERFORMED FOR *'MYCOPLASMA PULMONIS' ANTIBODY*
PLATE COATED WITH *'MYCOPLASMA PULMONIS' ANTIGEN*
ABSORBANCE MEASURED AT 405 NM. SPECIMEN DESCRIPTION *SERUM*

CONJUGATES: *RIG*

	1:20	1:100	1:20	1:100	1:20	1:100	1:	1:
BASELINE	109	053						
A	* 149	* 070						
B	+ 244	+ 102						
C	+ 759	+ 455						
D	* 110	* 054						
E	- 049	- 020						
F	+ 300	* 065						
G	*INS*	*INS*						
H	*INS*	- 001						
I	- 069	- 036						
J	*INS*	*INS*						

TECHNICIAN: *BATEMA, R.*

Fig. 10. ELISA panel, completed.

REPORT OF ELISA TESTING

ACCESSION NUMBER: 123456-83 DATE: FEBRUARY 16, 1983

AGENT TESTED FOR: *MYCOPLASMA PULMONIS* ANTIBODY
PLATE COATED WITH: *MYCOPLASMA PULMONIS* ANTIGEN
SPECIES TESTED: MOUSE SPECIMEN: SERUM
ABSORBANCE MEASURED AT 405 NM.

	CONJUGATE RIG	
DILUTION(S):	1:20	1:100
ID:		
A	*(0.149)	*(0.070)
B	+(0.244)	+(0.102)
C	+(0.759)	+(0.455)
D	*(0.110)	*(0.054)
E	-(0.049)	-(0.020)
F	+(0.300)	*(0.065)
G	INS	INS
H	INS	-(0.001)
I	-(0.069)	-(0.036)
J	INS	INS
BASE	(0.109)	(0.053)

LEGEND:

ID = ANIMAL OR SPECIMEN IDENTIFICATION
blank = TEST NOT PERFORMED
INS = INSUFFICIENT QUANTITY TO TEST
BASE = BASELINE = TWO STANDARD DEVIATIONS ABOVE THE MEAN ABSORBANCE VALUES OF KNOWN NEGATIVE SERA
+ = POSITIVE RESULTS (ABOVE BASELINE VALUE)
- = NEGATIVE RESULTS (BELOW BASELINE VALUE)
* = BORDERLINE OR EQUIVOCAL RESULTS (NEAR BASELINE VALUE)
(number) = ABSORBANCE VALUE
RIG = ANTI RAT IgG : ALKALINE PHOSPHATASE CONJUGATE

TECHNICIAN: BATEMA, R.

Fig. 10(a). ELISA panel, final report.

LAB DATA RODENT HISTOPATHOLOGY PANEL
CASE 123456 DATE 022583

ID	STO	DUO	JEJ	ILE	CEC	COL	PAN	LIV	SPL	KID	LUN	CBR	CBL	HDG	SAL	IWI
A								1	65	26				-	63	
B								-	-	31				-	54	
C								4	-	-				-	-	
D								9	68	31				-	54	
E								4	-	26				-	54	
F	76	-						9	-	-				-		
G	-	-						9	-	31				-		
H	-	-						1	72	-				-		
I	-	-						141	-	-				-		
J	-	-						141	-	31				-		

PATHOLOGIST *J. E. WAGNER*

Fig. 11. Histopathology panel, type 1, completed.

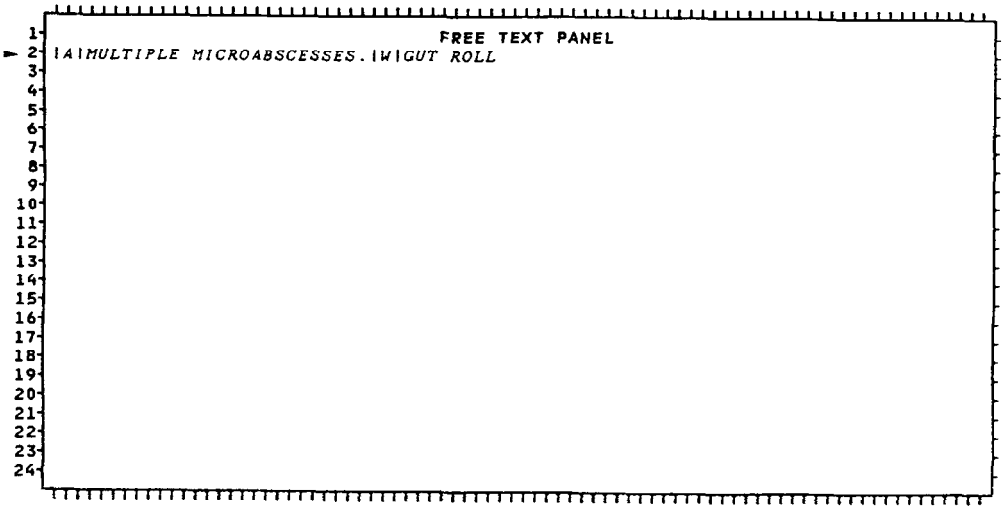

Fig. 11(a). Histopathology panel, type 1, free text panel.

REPORT OF HISTOPATHOLOGICAL EXAMINATION

ACCESSION NUMBER: 123456-83 DATE: FEBRUARY 25, 1983

ID	STOMACH	DUODENUM	JEJUNUM	ILEUM	CECUM	COLON	PANCREAS	LIVER	SPLEEN	KIDNEY	LUNG	CEREBRUM	CEREBELLUM	HARDERIAN GLAND	SALIVARY GLAND	GUT ROLL
A								1	65		26				NSL	63
B								NSL	NSL		31				NSL	54
C								4	NSL		NSL				NSL	NSL
D								9	68		31				NSL	54
E								4	NSL		26				NSL	54
F	76	NSL						9	NSL		NSL				NSL	
G	NSL	NSL						9	NSL		31				NSL	
H	NSL	NSL						1	72		NSL				NSL	
I	NSL	NSL						|A|	NSL		NSL			NSL	
J	NSL	NSL						|A|	NSL		31			NSL	

LEGEND:

NSL = NO SIGNIFICANT LESIONS
blank = ORGAN NOT EXAMINED MICROSCOPICALLY
1 = VERY MILD FOCAL HEPATITIS.
65 = EXCESSIVE EXTRAMEDULLARY HEMATOPOIESIS.
26 = MULTIPLE FOCI OF ACUTE PNEUMONITIS CHARACTERIZED BY MIXED INFLAMMATORY CELL INFILTRATES, VASCULITIS, AND NECROSIS - POSSIBLY REPRESENTING EARLY STAGES OF SENDAI VIRUS INFECTION.
63 = THE ENTIRE GUT ROLL WAS EXAMINED SPECIFICALLY FOR SYNCYTIAL CELL FORMATIONS INDICATIVE OF MOUSE HEPATITIS VIRUS INFECTION. NONE WERE FOUND. ADDITIONALLY WE FOUND NO EVIDENCE OF OTHER NATURALLY OCCURRING INFECTIOUS OR PARASITIC DISEASES.
31 = MULTIPLE PERIVASCULAR LYMPHOID AGGREGATIONS PLUS FOCI OF FOAMY MACROPHAGE ACCUMULATIONS IN ALVEOLI. THESE LESIONS ARE SUGGESTIVE OF SENDAI VIRUS INFECTION.
► 54 = MULTIPLE SYNCYTIA IN ABSORBING EPITHELIUM COVERING VILLI PATHOGNOMONIC OF MOUSE HEPATITIS VIRUS INFECTION.
4 = FOCAL HEPATITIS WITH NECROSIS.
9 = MULTIPLE FOCI OF HEPATITIS AND NECROSIS AND SYNCYTIA FORMATIONS PATHOGNOMONIC OF MOUSE HEPATITIS VIRUS INFECTION.
68 = MODERATE CONGESTION.
76 = TORULOPSIS SP.
72 = MARKED LYMPHOID HYPERPLASIA.
|A| = MULTIPLE MICROABSCESSES.

PATHOLOGIST: J. E. WAGNER

Fig. 11(b). Histopathology panel, type 1, final report.

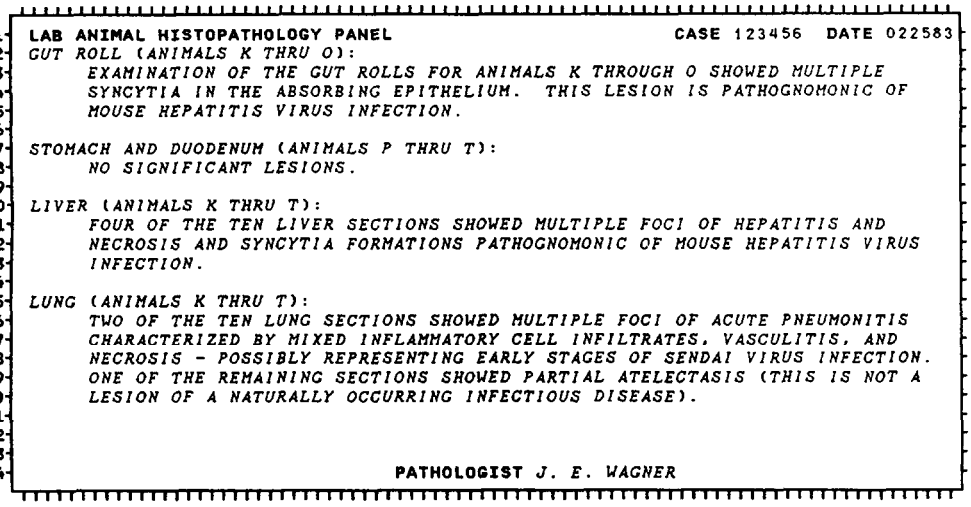

Fig. 12. Histopathology panel, type 2, completed.

REPORT OF HISTOPATHOLOGICAL EXAMINATION

ACCESSION NUMBER: 123456-83 DATE: FEBRUARY 25, 1983

GUT ROLL (ANIMALS K THRU O):
EXAMINATION OF THE GUT ROLLS FOR ANIMALS K THROUGH O SHOWED MULTIPLE SYNCYTIA IN THE ABSORBING EPITHELIUM. THIS LESION IS PATHOGNOMONIC OF MOUSE HEPATITIS VIRUS INFECTION.

STOMACH AND DUODENUM (ANIMALS P THRU T):
NO SIGNIFICANT LESIONS.

LIVER (ANIMALS K THRU T):
FOUR OF THE TEN LIVER SECTIONS SHOWED MULTIPLE FOCI OF HEPATITIS AND NECROSIS AND SYNCYTIA FORMATIONS PATHOGNOMONIC OF MOUSE HEPATITIS VIRUS INFECTION.

LUNG (ANIMALS K THRU T):
TWO OF THE TEN LUNG SECTIONS SHOWED MULTIPLE FOCI OF ACUTE PNEUMONITIS CHARACTERIZED BY MIXED INFLAMMATORY CELL INFILTRATES, VASCULITIS, AND NECROSIS - POSSIBLY REPRESENTING EARLY STAGES OF SENDAI VIRUS INFECTION. ONE OF THE REMAINING SECTIONS SHOWED PARTIAL ATELECTASIS (THIS IS NOT A LESION OF A NATURALLY OCCURRING INFECTIOUS DISEASE).

PATHOLOGIST: J. E. WAGNER

Fig. 12(a). Histopathology panel, type 2, final report.

Serology and ELISA panels (Figs 9 and 10)

The serology panel (Fig. 9) includes complete serology results only for those tests commonly performed, i.e. hemagglutination inhibition (HI) and complement fixation (CF) tests. In this case, a serological examination of aminals A–J was performed, using complement fixation tests and hemagglutination inhibition tests (Figs 9 and 9(a)).

The ELISA (enzyme linked immunosorbent assay) panel is used for reporting results of mouse hepatitis virus (MHV), rat coronavirus (RCV), Sendai virus, or Mycoplasma testing for serum antibodies (Fig. 10). An ELISA to test for *Mycoplasma pulmonis* antibody was performed on the sera of animals A–J (Figs 10 and 10(a)).

Histopathology panels (Figs 11 and 12)

There are two formats for entry of histopathology results. The first of these results in a tabular report (Fig. 11). Animal identification is entered on the left, and results are entered

under the appropriate organ or tissue examined microscopically in routine disease surveillance accessions (Fig. 11, line 4). Each cell in the table may be left blank (indicating that an organ or tissue was not examined for that animal), filled with a dash or minus sign (indicating no significant microscopic lesions were found in that organ or tissue for that animal), or a description of the lesions found can be entered using a two digit number from a directory (Fig. 11). To speed data entry and insure consistency, a directory of descriptions of common microscopic lesions was programmed which the computer interprets to narrative statements in English on the final report. The operator thus need only enter the code for a given lesion, for example, when one enters "54", the computer will translate it and "MULTIPLE SYNCYTIA IN ABSORBING EPITHELIUM COVERING VILLI PATHOGNOMONIC OF MOUSE HEPATITIS VIRUS INFECTION." will appear on the printed report (arrow on Fig. 11(b)). Descriptions of lesions not on the list can be entered by means of a free text reference (arrow in Fig. 11 on line 14) in the appropriate cell and by entering the appropriate text in the free text area for that panel, labeled with the same free text reference (Fig. 11(a)).

A second type of histopathology panel (Figs 12 and 12(a)) enables the pathologist to report the histopathology results when results are not easily reportable in the tabular format. Data

```
 1  SUMMARY OF FINDINGS                              CASE 123456  DATE 022583 ARCHIVE ?
 2  PRENECROPSY:     /        ROUGH HAIR COAT, PURULENT EXUDATE AROUND THE EYES.
 3  NECROPSY: 5  / 20     PURULENT EXUDATE IN TYMPANIC BULLAE
 4  PARA: ANAL TAPE: 20 / 20     'SYPHACIA OBVELATA' INFESTATION
 5   ECTOPARA: 20 / 20     'RADFORDIA AFFINIS' INFESTATION
 6   FECAL FLOAT:     /
 7   DIRECT EXAM: 20 / 20     'SYPHACIA OBVELATA' INFESTATION
 8   INT WET MOUNT:     /
 9  MICRO: NASOPHAR BA: 6  / 20     'PSEUDOMONAS AERUGINOSA'
10   NASOPHAR MYCOPLAS: 3  / 20     'MYCOPLASMA PULMONIS'
11   TRACH WASH BA: 6  / 6      'PSEUDOMONAS AERUGINOSA'
12   TRACH WASH MYCOPLAS: 8  / 10     'MYCOPLASMA PULMONIS'
13   ENTERIC PATHOGENS:     /
14  HISTOPATH:     /        LESIONS SUGGESTIVE OF SENDAI AND MHV VIRUS INFECT|Q|
15  SEROLOGY:     /        TITRES TO SENDAI, MHV, AND PVM. ELISA POSITIVES FOR|R|
16
17  DIAGNOSIS: SENDAI, MHV, AND PVM VIRUS INFECTIONS, MYCOPLASMOSIS, AND OTITIS MED
18 IA DUE TO 'PSEUDOMONAS AERUGINOSA'.
19
20  CONCORDANCE INDEX: KC$,A01235/KC$,A01236/SEROLOGY:SENDAI +/SEROLOGY:MHV +/SEROL
21 OGY:PVM +/EXP:DES TEST CASE/RES:PNEUMONIA-SENDAI/HL:HEPATITIS-FOCAL-MHV/HL:NECRO
22 SIS-FOCAL,MHV-LIVER/|S|
23  VMDL OFFICIAL: 1    FIRST NAME: JOSEPH E.        LAST NAME: WAGNER
24  TITLE PATHOLOGIST          DEGREES DVM, PH.D.
```

Fig. 13. Summary–concordance panel, completed.

```
 1                                  FREE TEXT PANEL
 2 |*|THIS IS A HYPOTHETICAL ACCESSION TO DEMONSTRATE THE UNIVERSITY OF MISSOURI RE
 3 SEARCH ANIMAL DIAGNOSTIC AND INVESTIGATIVE LABORATORY DATA ENTRY SYSTEM.|Q|IONS.
 4 |R| 'MYCOPLASMA PULMONIS'.|S|CULT AER:CITROBACTER FREUNDII-NONPATHOGENIC-CECUM/C
 5 ULT AER:STAPHYLOCOCCUS AUREUS-NASOPHARYNX/CULT AER:STAPHYLOCOCCUS AUREUS-LUNG/CU
 6 LT MYCOPLASMA:MYCOPLASMA PULMONIS-NASOPHARYNX/CULT AER:PROTEUS SPP-LUNG/CULT AER
 7 :E COLI-CECUM/CULT AER:ENTEROBACTER SPP-CECUM/CULT AER:PROTEUS SPP-CECUM/CULT AE
 8 R:PSEUDOMONAS AERUGINOSA-MID EAR/CULT AER:SALMONELLA TYPHIMURIUM-FECES/SYN:OTITI
 9 S MEDIA/SYN:SENDAI VIRUS INFECTION/SYN:MHV INFECTION/SENS:P AERUGINOSA-R,AM B LR
10  CM P TE SSS-I,E-S,C GM STR/|
11
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```

Fig. 13(a). Summary–concordance panel, free text panel.

FROM THE
RESEARCH ANIMAL DIAGNOSTIC AND INVESTIGATIVE LABORATORY
COLLEGE OF VETERINARY MEDICINE
UNIVERSITY OF MISSOURI, COLUMBIA, MISSOURI 65211

ACCESSION NUMBER: 123456-83 RECEIVED ON: FEBRUARY 15, 1983
INVESTIGATOR: MCLAUGHLIN, R. COMPLETED ON: FEBRUARY 25, 1983
SOURCE: UMC LABORATORY ANIMAL MEDICINE
REFERRED BY: WAGNER, J. E.
SUPPLIER: RAISED-UMC PATHOLOGY
SPECIES: MOUSE STRAIN: DBA/2NCRL
NUMBER EXAMINED: 20 AGE: MIXED SEX: MIXED

PRENECROPSY-PHYSICAL:
PLEASE SEE THE REPORT OF NECROPSY EXAMINATION. ROUGH HAIR COAT, PURULENT EXUDATE AROUND THE EYES.

NECROPSY:
5/20 PLEASE SEE THE REPORT OF NECROPSY EXAMINATION. PURULENT EXUDATE IN TYMPANIC BULLAE

PARASITOLOGY:
PERIANAL CELLOPHANE TAPE:
20/20 *SYPHACIA OBVELATA* INFESTATION

ECTOPARASITES - PELT:
20/20 *RADFORDIA AFFINIS* INFESTATION

DIRECT EXAM OF CECUM AND SMALL INTESTINE:
20/20 *SYPHACIA OBVELATA* INFESTATION

MICROBIOLOGY:
NASOPHARYNGEAL CULTURE ON BLOOD AGAR:
6/20 PLEASE SEE THE REPORT OF MICROBIOLOGICAL EXAMINATION.
PSEUDOMONAS AERUGINOSA

NASOPHARYNGEAL CULTURE ON MYCOPLASMA AGAR:
3/20 PLEASE SEE THE REPORT OF MICROBIOLOGICAL EXAMINATION.
MYCOPLASMA PULMONIS

TRACHEAL WASH CULTURED ON BLOOD AGAR:
6/10 *PSEUDOMONAS AERUGINOSA*

TRACHEAL WASH CULTURED ON MYCOPLASMA AGAR:
8/10 *MYCOPLASMA PULMONIS*

CULTURE FOR ENTERIC PATHOGENS:
10/10 NO ENTERIC PATHOGENS CULTURED.

HISTOPATHOLOGY:
PLEASE SEE THE REPORT OF HISTOPATHOLOGICAL EXAMINATION. LESIONS SUGGESTIVE OF SENDAI AND MHV VIRUS INFECTIONS.

SEROLOGY:
TITRES TO SENDAI, MHV, AND PVM. ELISA POSITIVES FOR *MYCOPLASMA PULMONIS*.

SUMMARY DIAGNOSIS:
SENDAI, MHV, AND PVM VIRUS INFECTIONS, MYCOPLASMOSIS, AND OTITIS MEDIA DUE TO *PSEUDOMONAS AERUGINOSA*.

Fig. 13(b). Summary–concordance panel, final report.

is entered in complete sentences or narrative form on this panel, and printed out exactly as entered. This format is useful for lengthy descriptions of lesions.

Summary–concordance panel (Fig. 13)

The summary of findings panel (Figs 13, 13(a) and 13(b)) includes a brief summary of laboratory results from other panels, along with a summary diagnosis and diagnostic information for concordance indexing. In the upper right hand corner (Fig. 13) is the "ARCHIVE?" field. As long as this field is left blank all panels with this accession number remain on line in the master file. This field is left blank until the accession is completely processed and all reports have been mailed. When the accession has been fully reported and all reports are mailed, this field is marked with an "X". Quarterly, accessions marked with an "X" in the "ARCHIVE?" field are removed from the master file and placed in a magnetic tape file.

About 25 technical and professional personnel enter data into the RADIL system described herein. After data has been captured through entry on the various panels, individual accession reports are generated interactively using a LA120 Decwriter II computer terminal located in the laboratory but connected to the host computer via low-noise phone lines and 1200 baud modems. One to three or four part carbonless paper is used in this terminal to provide printed copies of reports; one for the referring veterinarian, one for the owner or investigator, and one for the RADIL files. Reports can be designated either preliminary, final, or supplemental, and may optionally include only designated panel types.

Alternately, accessions can be printed centrally on campus on an IBM 3800 printing subsystem for twice daily delivery to our laboratory and subsequent mailing or distribution. Regardless of where accessions are printed, all mailing or distribution of reports is done by a data controller who controls the flow of accession material and subsequently generated data. At any time this key individual knows of the status of any accession that has entered the laboratory. Many telephone inquiries can be answered by the on-line Data Controller. Accessions are easily "tracked" through the laboratory. A special "Culprits" program flags any accession that has been in the laboratory over two weeks.

The advantages of the system described herein are many. Clean typed reports are issued. It is convenient and easy to provide complete reporting of diagnostic tests performed, i.e. positive as well as negative findings are reported. Multiple copies are generated without the need for preprinted forms. Errors are corrected electronically by data entry operators. Computer stored and accessed directories of complete mailing addresses of referring veterinarians and selected clients are entered by three digit code, thus speeding up data entry and improving accuracy and completeness of addresses. Use of window envelopes eliminates the need for addressing envelopes. There is no typing of reports *per se*, rather, data is entered from the laboratory by laboratory technicians or a data entry operator. Accession history and demographic–zoographic data is acquired for concordance indexing without the need for reentry. All data is held in a form accessible through Mark IV and specialized programs can be prepared for summarized reporting using an optional "display" mode. Additional panels can be created if needed, thus, allowing for future expansion. Availability of comprehensive user's manuals and interdigitated Standard Operating Procedures of laboratory procedures greatly facilitate training of new employees.

There are also several disadvantages to this system. It requires a high capacity computer running under IBM's MVS operating system, and IBM's 3278 series terminals. These are expensive, necessitating sharing with other users. This can produce prolonged response times during periods of maximal usage. Development of such a system as this requires the services of a computer programmer as well as considerable time. Data processing and storage costs are quite high. Nearly all laboratory technicians must be trained to enter data into the system. Consistency in terminology is necessary. Users' manuals must be prepared and updated periodically. The programs are extensively interdigitated, making certain types of program changes difficult.

SUMMARY

High case loads and the necessity for obtaining rapid diagnostic correlations prompted the development of an electronic computer based system of accession data management, storage, and retrieval in a large state-university Veterinary Medical Diagnostic Laboratory.

This system is capable of handling large volumes of diagnostic data such as results of histopathology, parasitology, necropsy, and microbiology as well as demographic data. This system uses the full screen capabilities of IBM 3278 model 2 computer terminals to display a blank panel (essentially a blank laboratory results form) which is filled in by laboratory technicians or data entry operators at the major data generating stations throughout the laboratory. Final reports are printed directly from this computer stored information. Individual accession records are kept in a VSAM data-base and archived to magnetic tape every quarter. Information from these records is abstracted as needed by the computer for an annual concordance index and other administrative reports.

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REFERENCES

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2. J. E. Wagner, H. B. Coleman, L. G. Morehouse, and P. C. Mann, A computerized system for retrieval of case information in a veterinary diagnostic laboratory, *Am. J. vet. Res.* **40**(3), 436–442 (1979).

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About the Author—WILLIAM JAMES WARRINER received a B.S. degree in Poultry Science at North Carolina State University, Raleigh, North Carolina, where he graduated with honors in 1977. He is currently attending the University of Missouri-Columbia where he is working on a Master of Science in Computer Science.

About the Author—SYLVIA A. BRADFIELD is an Administrative Assistant in the Research Animal Diagnostic and Investigative Laboratory, and has been in her present position for the past nine years. Mrs. Bradfield assisted in the design and development of the computer based system used in the Research Animal Diagnostic and Investigative Laboratory. She worked from 1960 to 1968 in the State Farm Insurance Regional Office in Columbia, Missouri as a data entry/verifier operator and secretary to a divisional supervisor. From 1972 to 1973 she was secretary to the Director of the Veterinary Medical Diagnostic Laboratory, and a secretary in the College of Veterinary Medicine Fiscal Office from 1973 to 1974.

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