U.S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 76-78-416

PEYTON PACKING COMPANY
EL PASO, TEXAS

AUGUST, 1977

I. TOXICITY DETERMINATION

IT HAS BEEN DETERMINED THAT A TOTAL OF FORTY-FOUR (44) CASES OF BRUCELLOSIS OCCURRED IN EMPLOYEES OF THE PEYTON PACKING COMPANY DURING THE PERIOD JUNE, 1975-AUGUST, 1976. THE EPIDEMIC RESULTED FROM SLAUGHTERING BRUCELLA-INFECTED CATTLE, WITH THE GREATEST RISK OF INFECTION OCCURRING AMONG PERSONNEL IN THE BEEF KILL, INEDIBLE RENDERING, HIDES, AND OFFAL DEPARTMENTS. PERSONNEL FROM OTHER DEPARTMENTS WHO FREQUENTLY WORKED IN THE BEEF KILL DEPARTMENT AS PART OF THEIR JOB WERE ALSO AT HIGH RISK OF INFECTION.

A POSITIVE ASSOCIATION WAS FOUND BETWEEN INFECTION AND THREE (3) POTENTIAL ROUTES OF INFECTION (CONTACT, CONJUNCTIVAL AND AIRBORNE). BECAUSE MANY OF THE INFECTED PERSONS COULD HAVE ACQUIRED THE DISEASE BY MORE THAN ONE ROUTE, THE RELATIVE IMPORTANCE OF THE THREE ROUTES COULD NOT BE DETERMINED. THE WEARING OF RUBBER GLOVES, MESH GLOVES, RUBBER APRONS, COVER-ALLS, OR EYEGLASSES COULD NOT BE DEMONSTRATED AS PROTECTION AGAINST INFECTION. OTHER THAN RESTRICTING ENTRY TO THE BEEF KILL DEPARTMENT, AND IMPROVING THE BRUCELLA ERADICATION IN THE ANIMALS, NO PRACTICAL METHOD FOR PREVENTING BRUCELLOSIS IN PLANT EMPLOYEES COULD BE DETERMINED.

THESE DETERMINATIONS ARE BASED ON THE RESULTS OF ADMINISTERED QUESTIONNAIRES AND SEROLOGIC TESTING CONDUCTED BY THE EL PASO CITY-COUNTY HEALTH DEPARTMENT (MARCH 1, 1976 AND APRIL 7, 1976) AND THE CENTER FOR DISEASE CONTROL (AUGUST 10, 1976).

TO PROMOTE PROMPT DIAGNOSIS AND THERAPY, SEVERAL RECOMMENDATIONS WERE MADE TO MANAGEMENT--SOME OF WHICH WERE THE INITIATION OF AN EDUCATIONAL PROGRAM FOR WORKERS AND SUPERVISORS; EMPLOYMENT OF A PLANT NURSE; AND A PROGRAM OF ACTIVE CASE DETECTION.

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III. INTRODUCTION

SECTION 20(A)(6) OF THE OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970, 29 U.S.C. 669 (A)(6), AUTHORIZES THE SECRETARY OF HEALTH, EDUCATION, AND WELFARE, FOLLOWING RECEIPT OF A WRITTEN REQUEST FROM AN EMPLOYER OR AUTHORIZED REPRESENTATIVE OF EMPLOYEES, TO DETERMINE WHETHER ANY SUBSTANCE NORMALLY FOUND IN THE PLACE OF EMPLOYMENT HAS POTENTIALLY TOXIC EFFECTS IN SUCH CONCENTRATIONS AS USED OR FOUND.

THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH) RECEIVED SUCH A REQUEST FROM MANAGEMENT REGARDING THE RELATIVELY HIGH INCIDENCE OF EMPLOYEES PREVIOUSLY DIAGNOSED AS HAVING BRUCELLOSIS.

IN OCTOBER, 1975, THE EL PASO CITY-COUNTY HEALTH DEPARTMENT, TEXAS, BEGAN TO RECEIVE AN INCREASING NUMBER OF REPORTS OF BRUCELLA INFECTION IN WORKERS AT THE PEYTON PACKING COMPANY, EL PASO, TEXAS. BECAUSE CASES CONTINUED TO OCCUR, THE HEALTH DEPARTMENT CONDUCTED QUESTIONNAIRE AND SEROLOGIC SURVEYS AT THE COMPANY ON MARCH 1, 1976, AND APRIL 7, 1976. A TOTAL OF 483 SERUM SPECIMENS WERE COLLECTED FROM 452 OF APPROXIMATELY 600 EMPLOYEES ON THESE TWO (2) DATES. SERUM SPECIMENS FROM EIGHT (8) ADDITIONAL EMPLOYEES WERE TESTED AT PRIVATE LABORATORIES IN THE PERIOD JANUARY - JUNE, 1976.

FORTY-EIGHT (48) OF THE 460 EMPLOYEES (10.4%) HAD BRUCELLA ANTIBODY TITERS $\geq$ 1:160. OF THE 48 EMPLOYEES, 34 REPORTED AN ILLNESS COMPATIBLE WITH BRUCELLOSIS. TEN ADDITIONAL EMPLOYEES HAD CLINICAL ILLNESS COMPATIBLE WITH BRUCELLOSIS BUT HAD TITERS $\leq$ 1:80.

HEALTH HAZARD EVALUATION

A. DESCRIPTION OF PROCESS

THE PEYTON PACKING COMPANY HAS BEEN IN OPERATION AT ITS CURRENT SITE SINCE MAY, 1967. PRIOR TO THAT TIME, ITS OPERATIONS WERE CONDUCTED IN AN AREA CEDED TO MEXICO WHEN THE UNITED STATES-MEXICO BORDER WAS ADJUSTED BY THE CHAMIZAL TREATY DURING THE 1960'S.

THE COMPANY NORMALLY HAS A WORK FORCE OF APPROXIMATELY THREE HUNDRED SIXTY PRODUCTION EMPLOYEES. HOWEVER, AT THE TIME OF THE EVALUATION, ONLY 310 PRODUCTION WORKERS WERE EMPLOYED DUE TO A TEMPORARY REDUCTION IN CATTLE SLAUGHTER. THE WORK FORCE IS CONSIDERED STABLE.

MINOR TRAUMATIC WOUNDS ARE TREATED BY INDIVIDUALS IN THE PERSONNEL OFFICE OF THE PLANT. MORE SERIOUS INJURIES AND MEDICAL COMPLAINTS ARE REFERRED TO A LOCAL CLINIC, ALTHOUGH EMPLOYEES ARE FREE TO, AND DO, UTILIZE THEIR OWN PHYSICIANS FOR TREATMENT OF JOB-RELATED ILLNESSES AND INJURIES.

THE COMPANY HAD NO RECORD OF BRUCELLA INFECTION IN ITS EMPLOYEES BEFORE 1975. HOWEVER, TWO (2) CASES (ONE IN 1968 AND ONE IN 1973) WERE REPORTED RETROSPECTIVELY BY EMPLOYEES DURING THE EVALUATION. BRUCELLOSIS ACQUIRED FROM CONSUMPTION OF UNPASTEURIZED MEXICAN DAIRY PRODUCTS IS A LOW-LEVEL ENDEMIC PROBLEM IN AREA RESIDENTS.

ONLY CATTLE ARE SLAUGHTERED AT THE PLANT. HOWEVER, PORK IS PURCHASED FOR PRODUCTION OF HAM, BACON, AND SAUSAGE. CATTLE ARE PURCHASED FOR SLAUGHTER IN NEW MEXICO (50%), TEXAS (35%), AND ARIZONA (15%). MOST OF THE CATTLE SLAUGHTERED ARE STEERS AND HEIFERS, BUT COWS AND BULLS ARE ALSO SLAUGHTERED.

THE NUMBER AND PERCENTAGE OF CATTLE IN EACH CATEGORY SLAUGHTERED FLUCTUATE DEPENDING ON MARKET SUPPLY AND DEMAND.

CATTLE TRUCKED TO THE PLANT ARE UNLOADED INTO TEMPORARY HOLDING PENS PRIOR TO BEING DRIVEN UP THE RAMP TO THE STUNNING CHUTE. AFTER BEING RENDERED UNCONSCIOUS BY A CAPTIVE BOLT MECHANISM, CATTLE ARE SHACKLED, EXSANGUINATED, DECAPITATED, AND THE APPENDAGES ARE DISARTICULATED AT THE CARPAL OR TARSAL JOINTS. REMOVAL OF THE HIDE IS STARTED BY BUTCHERS WHO SPLIT THE HIDE BY MAKING INCISIONS ALONG THE MEDIAL ASPECTS OF THE FOUR LEGS AND ALONG THE VENTRAL MIDLINE. AFTER THE HIDE IS REFLECTED TOWARD THE SHOULDERS, CHAINS FROM AN AUTOMATIC HIDE PULLER ARE ATTACHED TO THE SKIN FLAPS FROM THE FORE-LEGS AND THE HIDE IS PULLED OFF THE REST OF THE CARCASS. THE CARCASS IS THEN EVISCERATED, SPLIT, WASHED, SHROUDED, AND MOVED INTO THE HOT BEEF COOLER FOR 24 HOURS. FROM THE HOT BEEF COOLER, THE SPLIT CARCASSES ARE EITHER SHIPPED DIRECTLY TO RETAIL MARKETS OR FURTHER BROKEN DOWN IN THE BEEF FAB-RICATION DEPARTMENT. PROCESSING OF HEADS AND SEPARATION OF VISCERA ARE DONE IN THE KILL DEPARTMENT.

PORK PROCESSING IS DONE IN ROOMS SEPARATED FROM THE BEEF PROCESSING AREAS.

B. EVALUATION DESIGN

ON AUGUST 10, 1976, AN ENVIRONMENTAL/MEDICAL WALK-THROUGH SURVEY WAS CONDUCTED OF THE FACILITY. DURING THE PERIOD AUGUST 11-19, 1976, APPROPRIATE QUESTION-NAIRES WERE ADMINISTERED AND SEROLOGIC TESTING CONDUCTED.

VENTILATION MEASUREMENTS WERE TAKEN IN THE BEEF KILL DEPARTMENT TO INSURE THAT ANY AEROSOLS, ETC. GENERATED IN THAT WORK AREA WERE NOT BEING PERMITTED TO ENTER OTHER WORK AREAS. NO OTHER ''ENVIRONMENTAL EVALUATIONS'' WERE CONDUCTED.

C. EVALUATION CRITERIA

1. MEDICAL

BRUCELLOSIS IS AN ACUTE, SUBACUTE OR INSIDIOUS INFECTION WITH A HIGHLY VARIABLE CLINICAL PICTURE. GENERALLY, IT IS CHARACTERIZED BY CONTINUED, INTERMITTENT OR IRREGULAR FEVER OF VARIABLE DURATION ACCOMPANIED BY WEAKNESS, SWEATING, CHILLS AND PAIN IN THE JOINTS, MUSCLES AND HEAD. IN CHRONIC BRUCELLOSIS, SYMPTOMS MAY BE VAGUE AND MAY RESEMBLE THOSE OF OTHER SYSTEMIC DISEASES AND EVEN MENTAL DISEASE. THE DISEASE MAY LAST FOR SEVERAL DAYS, MANY MONTHS, OR OCCASIONALLY SEVERAL YEARS.

ALTHOUGH MORTALITY IS LOW, THE CLINICAL DISEASE IS INCAPACITATING AND SERIOUSLY UNDERMINES THE WORKING CAPACITY OF THE PATIENT. THIS FACT, ALONG WITH ITS FREQUENCY IN WORKERS ENGAGED IN ANIMAL HUSBANDRY AND INDUSTRIES EMPLOYING ANIMAL PRODUCTS IN ENDEMIC AREAS, MAKES IT THE MOST IMPORTANT OCCUPATIONAL INFECTION OF ANIMAL ORIGIN. IN SPITE OF ITS IMPORTANCE, IT IS NOT YET LEGALLY RECOGNIZED AS AN OCCUPATIONAL DISEASE IN MANY COUNTRIES WHERE IT IS ENDEMIC.

EXPOSURES ARE ALMOST ALWAYS OCCUPATIONAL AND ARE COMMON AMONG VETERINARIANS, ANIMAL ATTENDANTS, STOCK FARMERS, ABATTOIR AND PACKING HOUSE WORKERS, EMPLOYEES OF RENDERING PLANTS AND OTHER HANDLERS OF ANIMAL AND ANIMAL PRODUCTS.

THE COMMON MODE(S) OF TRANSMISSION ARE BY CONTACT WITH TISSUES, BLOOD, URINE, VAGINAL DISCHARGES, ABORTED FETUSES AND ESPECIALLY PLACENTAS, AND BY INGESTION OF MILK OR DAIRY PRODUCTS (CHEESE) FROM INFECTED ANIMALS. AIRBORNE INFECTION MAY OCCUR FROM ANIMALS IN PENS AND STABLES; ALSO IN LABORATORIES AND ABATTOIRS.

LABORATORY DIAGNOSIS IS BY ISOLATION OF THE INFECTIOUS AGENT FROM BLOOD, BONE MARROW OR OTHER TISSUES, OR FROM DISCHARGES FROM THE PATIENT. RECOVERY IS USUAL BUT DISABILITY IS OFTEN PRONOUNCED.

D. EVALUATION METHODS

INFORMATION ON PREVIOUSLY DIAGNOSED BRUCELLOSIS CASES IN PLANT EMPLOYEES WAS OBTAINED BY REVIEWING RECORDS AT THE EL PASO CITY-COUNTY HEALTH DEPARTMENT AND AT LOCAL PHYSICIANS' OFFICES. IN ADDITION, PERSONS PREVIOUSLY IDENTIFIED AS HAVING HAD BRUCELLOSIS WHO WERE STILL EMPLOYED AT THE COMPANY WERE INCLUDED IN THE SEROLOGIC AND QUESTIONNAIRE SURVEYS. DATA OBTAINED IN THE MARCH 1, 1976, AND APRIL 7, 1976, SEROSURVEYS WERE MADE AVAILABLE FOR OUR USE BY THE LOCAL HEALTH DEPARTMENT.

FOR THE QUESTIONNAIRE AND SEROLOGIC SURVEY, A SAMPLE SIZE SUFFICIENT TO ESTIMATE WITHIN $\pm$5% THE ASCRIBED ATTACK RATE (THE ACTUAL ATTACK RATE IN THE PRECEDING 12 MONTHS OR A 5% ATTACK RATE IF IT WERE LESS THAN 5%) WITH 95% CONFIDENCE INTERVALS WAS DETERMINED. THE FINITE POPULATION CORRECTION WAS THEN APPLIED BASED ON THE TOTAL NUMBER OF EMPLOYEES IN EACH DEPARTMENT. IN THE CASE OF DEPARTMENTS WITH A LOW ATTACK RATE, A SMALL NUMBER OF EMPLOYEES, AND WORK WHICH ENTAILED COMPARABLE EXPOSURE TO ANIMAL TISSUES, THE POPULATIONS WERE COMBINED. A SYSTEMATIC SAMPLE OF PARTICIPANTS WAS SELECTED FROM THE DEPARTMENTAL SENIORITY ROSTER BY SELECTING AT A REGULAR INTERVAL APPROPRIATE FOR THE DESIRED SAMPLE SIZE AND NUMBER OF DEPARTMENTAL EMPLOYEES, E.G. EVERY SECOND OR THIRD NAME. IF THE SELECTED EMPLOYEES WERE ABSENT OR DID NOT WISH TO PARTICIPATE THEY WERE DROPPED FROM THE STUDY WITHOUT REPLACEMENT. THIS DECREASED THE ATTAINED SAMPLE SIZE BY 27%.

PERSONS IN WHOM BRUCELLOSIS HAD BEEN PREVIOUSLY DIAGNOSED BUT WHO WERE NOT INCLUDED IN THE SAMPLE POPULATION AND UNSOLICITED VOLUNTEERS WERE ALSO QUESTIONED AND BLED FOR SEROLOGIC TESTING. RESPONSES FROM NON-SAMPLE PARTICIPANTS WERE USED IN DETERMINING THE MINIMUM ATTACK RATES AND CHARACTERIZING THE ILLNESS; BUT WERE NOT UTILIZED IN THE CALCULATION OF SEROPOSITIVITY RATES TO DETERMINE RISK FACTORS.

EACH PARTICIPANT WAS PERSONNALLY INTERVIEWED, USING AN INTERPRETER WHEN NECESSARY, TO OBTAIN THE FOLLOWING INFORMATION: AGE; SEX; PAST AND PRESENT ABATTOIR EMPLOYMENT BY DATE, COMPANY AND JOB; DEGREE OF SKIN AND CONJUNCTIVAL CONTACT WITH ANIMAL TISSUES; EXPOSURE TO AIR IN THE KILL-ROOM; FREQUENCY OF INGESTION OF MEAT AND MEAT PRODUCTS BEING PROCESSED; FREQUENCY OF CUTS, SCRATCHES, OR ABRASIONS ON THE JOB; USE OF PROTECTIVE EQUIPMENT; POSSIBLE SOURCES OF BRUCELLA INFECTION NOT RELATED TO EMPLOYMENT; PRIOR DIAGNOSIS OF CLINICAL BRUCELLOSIS; AND, ILLNESS HISTORY IN THE PRECEDING YEAR.

THE DEGREE OF POTENTIAL BRUCELLA EXPOSURE VIA SKIN CONTACT WAS ASSESSED BY ASSIGNING A CONTACT COEFFICIENT TO EACH EMPLOYEE SURVEYED. CONTACT COEFFICIENTS WERE CALCULATED AS FOLLOWS: AN INJURY FACTOR BASED UPON THE FREQUENCY OF JOB-RELATED CUTS, SCRATCHES, OR ABRASIONS WAS ASSIGNED

(5 INDICATED 3 OR MORE CUTS PER WEEK; 4 INDICATED 1-2 CUTS PER WEEK; 3 INDICATED 1 CUT PER WEEK; 2 INDICATED 1 CUT PER 3-4 WEEKS; 1 INDICATED LESS THAN 1 CUT PER MONTH).THIS NUMERICAL VALUE WAS MULTIPLIED BY A CONTACT FACTOR DETERMINED BY THREE VARIABLES (WHETHER MEAT PRODUCT HANDLED WAS FRESHLY KILLED, CHILLED, OR CURED OR COOKED; AREA OF BODY HAVING CONTACT AND PERCENT OF WORK TIME DURING WHICH CONTACT OCCURRED) TO ARRIVE AT THE CONTACT COEFFICIENT FOR A GIVEN EMPLOYEE (TABLE 1). THE DEGREE OF CONJUNCTIVAL EXPOSURE WAS ASSESSED BY THE FREQUENCY WITH WHICH THE RESPONDENT'S FACE WAS SPLATTERED WITH POTENTIALLY INFECTIOUS TISSUES AND FLUIDS ON A WEEKLY BASIS. THE DEGREE OF EXPOSURE BY INGESTION OF MEAT AND MEAT PRODUCTS WAS ASSESSED BY THE FREQUENCY WITH WHICH SUCH PRODUCTS WERE CONSUMED ON THE PROCESSING LINE ON A WEEKLY BASIS.

BECAUSE PRIOR INVESTIGATIONS HAVE IMPLICATED INHALATION OF INFECTIOUS AEROSOLS GENERATED IN THE KILL-ROOMS OF ABATTOIRS AS A ROUTE OF INFECTION, RESPONDENTS WERE ALSO CATEGORIZED BY DEGREE OF EXPOSURE TO KILL-ROOM AIR. CATEGORIES USED WERE NONE (NO EXPOSURE), OCCASIONAL (0-1 HOUR/DAY), AND CONSIDERABLE (>1HOUR/DAY).

SERUM SPECIMENS FROM PARTICIPANTS WERE TESTED FOR THE PRESENCE OF BRUCELLA ANTIBODY USING STANDARD TUBE AGGLUTINATION (STA), CENTRIFUGATION-AGGLUTINATION (CA), 2-MERCAPTOETHANOL DEGRADATION (2ME), AND 2-MERCAPTOETHANOL DEGRADATION CENTRIFUGATION-AGGLUTINATION (2ME-CA) PROCEDURES. THE STA AND 2ME TEST RESULTS WERE DETERMINED AFTER 48 HOURS STATIC INCUBATION OF THE SERIALLY DILUTED SERUM SPECIMEN IN A 37° C WATERBATH. THE SERIAL DILUTIONS WERE THEN CENTRIFUGED AT APPROXIMATELY 700 G. FOR 10 MINUTES TO DETERMINE THE CA AND 2ME-CA TITERS. THE CA TITER WAS USED IN CALCULATING SEROPOSITIVITY RATES. WITH THIS EXCEPTION, UNQUALIFIED REFERENCE TO TITER MEANS THE STA TITER.

NUMBERS OF CATTLE SLAUGHTERED FROM JULY, 1974 TO JULY, 1976 BY CATEGORY (STEERS, HEIFERS, BULLS AND COWS) WERE OBTAINED FROM THE COMPANY. THE NUMBER OF BRUCELLA REACTOR CATTLE SLAUGHTERED IN THE PLANT DURING THAT PERIOD WERE OBTAINED FROM THE UNITED STATES DEPARTMENT OF AGRICULTURE. THE TOTAL NUMBER OF BRUCELLA REACTOR CATTLE SLAUGHTERED INCLUDED THOSE KNOWN TO HAVE SEROLOGIC EVIDENCE OF INFECTION PRIOR TO SLAUGHTER USUALLY AS THE RESULT OF TESTING KNOWN INFECTED HERDS, AND THOSE DETECTED BY SCREENING COWS AND BULLS OF UNKNOWN SEROLOGIC STATUS AT THE TIME OF SLAUGHTER. STEERS AND HEIFERS WERE NOT SEROLOGICALLY SCREENED. THE ESTIMATED PERCENTAGES OF BRUCELLA INFECTED CATTLE WERE ALSO OBTAINED FROM THE USDA FOR STATES WHERE SLAUGHTERED CATTLE HAD ORIGINATED.

THE POTENTIAL FOR AIR FROM THE KILL ROOM ENTERING OTHER PROCESSING AREAS WAS ASSESSED BY LOCATING AIR INTAKES AND OUTLETS FOR THE PROCESSING AREAS AND DETERMINING WHETHER AIR EXHAUSTED FROM THE KILL FLOOR COULD REASONABLY ENTER AIR INTAKES FOR OTHER AREAS. AIR FLOW PATTERNS IN THE KILL ROOM AND THE POTENTIAL FOR MOVEMENT INTO ADJOINING AREAS WAS DETERMINED WITH SMOKE TUBES.

DEFINITIONS

THE FOLLOWING DEFINITIONS WERE USED TO CATEGORIZE EMPLOYEES BY CLINICAL AND SEROLOGIC STATUS:

1. CONFIRMED CASE - HISTORY OF AT LEAST FOUR SIGNS AND SYMPTOMS COMPATIBLE WITH BRUCELLOSIS (FEVER, CHILLS, WEIGHT LOSS, DIAPHORESIS, GENERALIZED ACHING, WEAKNESS, PERSISTENT HEADACHE, AND ANOREXIA) AND A 4-FOLD OR GREATER CHANGE IN BRUCELLA ANTIBODY TITER BETWEEN TWO OR MORE SERUM SPECIMENS;

2. PRESUMPTIVE CASE - HISTORY OF AT LEAST FOUR SIGNS AND SYMPTOMS COMPATIBLE WITH BRUCELLOSIS AND EITHER A TITER $\geq$ 1:160 IN A SINGLE SERUM SPECIMEN, OR A TITER $\geq$ 1:160 IN AT LEAST ONE SERUM SPECIMEN BUT LESS THAN A 4-FOLD CHANGE IN TITER IN SERIALLY COLLECTED SPECIMENS;

3. SUSPECT CASE - HISTORY OF AT LEAST FOUR SIGNS AND SYMPTOMS COMPATIBLE WITH BRUCELLOSIS AND EITHER A TITER $\leq$ 1:180 OR NO SEROLOGIC EVALUATION;

4. ASYMPTOMATIC CASE - NO HISTORY OF ILLNESS COMPATIBLE WITH BRUCELLOSIS AND A TITER $\geq$ 1:160.

5. SEROPOSITIVE - CA TITER $\geq$ 1:160 WITH OR WITHOUT A HISTORY OF BRUCELLOSIS.

THE FOLLOWING DEFINITIONS WERE USED TO CATEGORIZE WORK DEPARTMENTS BY RELATIVE RISK FOR ACQUISITION OF BRUCELLA INFECTIONS FROM CONTACT OR AEROSOL:

1. STAGE I OPERATIONS - ACTIVITIES PRIOR TO EXPOSURE TO DEEP TISSUES IN THE SLAUGHTERING PROCESS (SUCH AS DRIVING LIVESTOCK, STUNNING, SHACKLING, AND BLEEDING) WHICH WOULD BE EXPECTED TO ENTAIL LOW RISK OF CONTACT EXPOSURE AND NO SIGNIFICANT AEROSOL EXPOSURE;

2. STAGE II OPERATIONS - ACTIVITIES IN AREAS WHERE THE DEEP TISSUES OF FRESHLY KILLED CATTLE ARE HANDLED (SUCH AS THE BEEF KILL DEPARTMENT) WHICH WOULD BE EXPECTED TO ENTAIL HIGH RISK OF BOTH CONTACT AND AEROSOL EXPOSURE;

3. STAGE III OPERATIONS - ACTIVITIES RELATED TO PROCESSING AFTER CHILLING OR COOKING OF TISSUES AND TO THE HIDE DEPARTMENT WHICH WOULD BE EXPECTED TO ENTAIL MODERATE CONTACT BUT NO SIGNIFICANT AEROSOL EXPOSURE;

4. MIXED OPERATIONS - ACTIVITIES RESULTING IN IRREGULAR EXPOSURE TO STAGE I, II, AND III OPERATIONS SUCH AS MAINTENANCE;

5. NON-PROCESSING OPERATIONS - ACTIVITIES CONDUCTED IN NON-PRODUCTION AREAS SUCH AS THE OFFICE WHERE NO SIGNIFICANT CONTACT OR AEROSOL EXPOSURE WOULD BE EXPECTED.

E. EVALUATION RESULTS

1. MEDICAL

INFORMATION OBTAINED IN THE INVESTIGATION REVEALED THAT A TOTAL OF FORTY-SIX (46) CASES OF BRUCELLOSIS OCCURRED IN EMPLOYEES OF THE PEYTON PACKING COMPANY IN THE PERIOD DECEMBER, 1968 - AUGUST, 1976, INCLUDING ELEVEN (11) CONFIRMED CASES, TWENTY-EIGHT (28) PRESUMPTIVE CASES, AND SEVEN (7) SUSPECT CASES. ALL BUT TWO (2) CASES, ONE (1) WITH ONSET IN DECEMBER, 1968 AND ONE (1) WITH ONSET IN MAY, 1973, OCCURRED IN THE EPIDEMIC PERIOD JUNE, 1975 - AUGUST, 1976 (FIGURE 1). CASES OCCURRED

IN EVERY MONTH OF THE EPIDEMIC PERIOD EXCEPT AUGUST, 1975, WITH A PEAK OF NINE (9) CASES IN FEBRUARY, 1976.

IN ALL CASES, SIGNS AND SYMPTOMS ASSOCIATED WITH ILLNESS WERE COMPARABLE, WHETHER CONFIRMED, PRESUMPTIVE, OR SUSPECT (TABLE 2). THE MEDIAN DURATION OF ILLNESS WAS 21 DAYS (MEAN 39 DAYS), WITH A RANGE OF 3 TO 180 DAYS. FOURTEEN OF THE 46 PATIENTS (30.4%) WERE HOSPITALIZED, AND THE MEAN DURATION OF HOSPITALIZATION WAS 10 DAYS (RANGE 3 TO 21 DAYS) IN TWELVE (12) PATIENTS FOR WHOM INFORMATION WAS AVAILABLE.

THE ATTACK RATE IN THE 1975-1976 EPIDEMIC PERIOD WAS HIGHEST (31%) IN EMPLOYEES ENGAGED IN STAGE II PROCESSING OPERATIONS AT THE TIME OF CLINICAL ONSET OF THEIR ILLNESS (TABLE 3). THE ATTACK RATE IN PROCESSING EMPLOYEES WHO WORKED EXCLUSIVELY WITH BEEF (34/207) WAS SIGNIFICANTLY GREATER THAN IN THOSE WHO WORKED EXCLUSIVELY WITH PORK (1/47) (FISHER'S EXACT TEST, 1-TAILED: $P = 0.005$).

IN AFFECTED BEEF PROCESSING DEPARTMENTS WHERE EMPLOYEES HAD POTENTIAL CONTACT WITH TISSUES OF FRESHLY KILLED ANIMALS, THE ATTACK RATES WERE COMPARABLE (FIGURE 2). HOWEVER, IN AFFECTED DEPARTMENTS WHERE CONTACT OCCURRED DURING AND AFTER CHILLING (BEEF COOLER, BEEF FABRICATION), THE ATTACK RATE WAS SIGNIFICANTLY LOWER (FISHERS EXACT TEST, 1-TAILED: $P = 0.01$).

BECAUSE EMPLOYMENT SENIORITY RECORDS WERE USUALLY MAINTAINED BY DEPARTMENT OF INITIAL EMPLOYMENT, ATTACK RATES IN EMPLOYEES OF AFFECTED DEPARTMENTS WERE ANALYZED BY TOTAL DURATION OF EMPLOYMENT RATHER THAN BY DURATION OF EMPLOYMENT IN THE DEPARTMENT WHERE THEY WERE WORKING AT THE TIME OF CLINICAL ONSET. THE ATTACK RATE BY DURATION OF PLANT EMPLOYMENT IN EMPLOYEES OF AFFECTED DEPARTMENTS WAS 64% (9/14) FOR LESS THAN 1 YEAR, 23% (17/73) FOR 1-4 YEARS, AND 10% (18/182) FOR 5-9 YEARS. THE DECLINING ATTACK RATE BY DURATION OF EMPLOYMENT WAS MOST STRIKING IN THE STAGE II PROCESSING EMPLOYEES (TABLE 4).

THE OCCURRENCE OF BRUCELLOSIS IN COMPANY EMPLOYEES WAS MOST LIKELY DUE TO OCCUPATIONAL EXPOSURE. NO EVIDENCE WAS FOUND OF A BRUCELLOSIS EPIDEMIC IN AREA RESIDENTS. OF 37 EMPLOYEES WHO HAD BRUCELLOSIS IN THE PAST 12 MONTHS, AND WERE AVAILABLE FOR INTERVIEW, ONLY THREE (3) REPORTED CONSUMING UNPASTEURIZED DAIRY PRODUCTS AND TWO (2) REPORTED CONTACT WITH DOMESTIC LIVESTOCK, SPECIFICALLY CATTLE. THE TWO (2) INDIVIDUALS HAVING CONTACT WITH CATTLE REPORTED THAT THESE ANIMALS HAD NO EVIDENCE OF REPRODUCTIVE DISEASE TO THEIR KNOWLEDGE.

COMPARISON OF CASES AND NUMBER OF CATTLE SLAUGHTERED BY MONTH SUGGESTED A RELATIONSHIP BETWEEN DISEASE AND THE NUMBER OF CATTLE, AND MORE SPECIFICALLY COWS AND BULLS, SLAUGHTERED (FIGURE 1). HOWEVER, THE NUMBER OF COWS AND BULLS SLAUGHTERED THAT HAD SEROLOGIC EVIDENCE OF BRUCELLA INFECTIONS DID NOT CORRELATE WELL WITH DISTRIBUTION OF CASES BY MONTH, EVEN IF AN INCUBATION PERIOD OF UP TO THREE MONTHS IS ASSUMED. BECAUSE STEERS AND HEIFERS WERE NOT SCREENED FOR THE PRESENCE OF BRUCELLA ANTIBODY AT TIME OF SLAUGHTER, NO INFORMATION WAS AVAILABLE ON THE TOTAL NUMBER OF CATTLE SLAUGHTERED THAT HAD SEROLOGIC EVIDENCE OF INFECTION.

BASED ON USDA DATA ON BRUCELLOSIS INFECTION RATES FOR THE THREE STATES FROM WHICH CATTLE WERE OBTAINED, THERE HAD BEEN AN UPWARD TREND IN ARIZONA AND NEW MEXICO (SOURCE STATES FOR 65% OF THE CATTLE SLAUGHTERED) IN FISCAL YEARS 1975-1976 COMPARED WITH 1973-1974 (TABLE 5). WHETHER THIS UPWARD-TREND WAS DIRECTLY RELATED TO THE UNUSUAL INCIDENCE OF CASES IN PLANT EMPLOYEES IN 1975-1976 IS UNCERTAIN.

NO SIGNIFICANT CHANGES HAD OCCURRED IN PLANT STRUCTURE SINCE IT WENT INTO OPERATION IN MAY, 1967. OPERATIONAL PROCEDURES HAD ALSO REMAINED BASICALLY UNCHANGED, WITH TWO EXCEPTIONS; THE SLAUGHTER RATE OF 28 CATTLE PER HOUR IN 1967 HAD INCREASED TO 58 CATTLE PER HOUR IN THE FIRST FEW YEARS OF OPERATION, AND CATTLE WERE PROCESSED IN TWO WORK SHIFTS IN THE PERIOD APRIL, 1975 TO APRIL, 1976.

A. THE SEROSURVEY

IN AUGUST, 1976, SERUM SPECIMENS WERE COLLECTED FROM 182 EMPLOYEES. THESE INCLUDED THE 158 PARTICIPANTS IN THE RANDOM SURVEY, SEVEN (7) PERSONS WITH PRIOR BRUCELLOSIS NOT INCLUDED IN THE RANDOM SURVEY, AND SEVENTEEN (17) PERSONS WITH NO PRIOR HISTORY OF BRUCELLOSIS WHO REQUESTED SEROLOGIC TESTING. A SIGNIFICANT CORRELATION WAS FOUND IN THIS GROUP BETWEEN A CA TITER $\geq$ 1:160 AND/OR A 2ME-CA TITER $>$ 1:20 AND A HISTORY OF PRIOR BRUCELLOSIS (CHI SQUARE: $P < 0.001$). (TABLE 6). OF THIRTY SEVEN (37) EMPLOYEES REPORTING ILLNESS COMPATIBLE WITH BRUCELLOSIS WITHIN 12 MONTHS PRIOR TO THE SURVEY 33 (89%) HAD CA TITERS $>$ 1:160 AND 24 (65%) HAD 2ME-CA TITERS $\geq$ 1:20. THE PRESENCE OF 2ME RESISTANT ANTIBODY IS ASSOCIATED WITH RECENT OR CURRENT BRUCELLA INFECTIONS.

THE DISTRIBUTION OF SEROPOSITIVITY IN PLANT EMPLOYEES PARTICIPATING IN THE RANDOM SURVEY CLOSELY PARALLELED THE DISTRIBUTION OF CASES (TABLE 7). AFTER EXCLUDING PERSONS WHO HAD WORKED IN THE BEEF KILL DEPARTMENT IN THE PRECEDING 12 MONTHS, BUT WHOSE CURRENT JOB DID NOT REQUIRE WORK IN THAT DEPARTMENT, APPROXIMATELY 50% OF STAGE I, STAGE II, AND MIXED OPERATIONS EMPLOYEES WERE SEROPOSITIVE, COMPARED WITH 10% OF STAGE III AND NONPROCESSING OPERATIONS EMPLOYEES. THE SEROPOSITIVITY RATE IN WORKERS WHOSE JOB ENTAILED ONLY PROCESSING OF BEEF (25/69) WAS SIGNIFICANTLY DIFFERENT THAN IN THOSE WORKERS PROCESSING ONLY PORK (1/18) CHI SQUARE: $P < 0.003$).

IN BEEF PROCESSING DEPARTMENTS WHERE CASES HAD OCCURRED, THE SERO-POSITIVITY RATE ALSO PARALLELED THE DISTRIBUTION OF CASES (FIGURE 3). BOTH THE SEROPOSITIVITY AND ATTACK RATES IN DEPARTMENTS WHERE CONTACT OCCURRED DURING AND AFTER CHILLING (BEEF COOLER, BEEF FABRICATION) WERE SIGNIFICANTLY LOWER THAN IN DEPARTMENTS WHERE CONTACT WITH TISSUES OF FRESHLY KILLED CATTLE OCCURRED (FISHER'S EXACT TEST, 1-TAILED: $P < 0.01$).

AFTER ELIMINATING DEPARTMENTS HAVING NO SEROPOSITIVE EMPLOYEES FROM CONSIDERATION, WE FOUND THAT SEROPOSITIVITY RATES BY DEPARTMENTAL SENIORITY WERE NOT SIGNIFICANTLY DIFFERENT (TABLE 8). HOWEVER, PERSONS WITH 1-4 YEARS PLANT SENIORITY HAD A SIGNIFICANTLY HIGHER SEROPOSITIVITY RATE THAN PERSONS WITH 5-9 YEARS PLANT SENIORITY (FISHER'S EXACT TEST, 1-TAILED: $P < 0.04$). BECAUSE RISK OF IN-FECTION APPEARS MORE RELATED TO SPECIFIC DEPARTMENTS THAN TO THE

PLANT AS A WHOLE, DEPARTMENTAL SENIORITY IS MORE MEANINGFUL FOR THIS ANALYSIS.

IN THE BEEF KILL DEPARTMENT, SEROPOSITIVE PERSONS PERFORMED A VARIETY OF JOBS AT LOCATIONS THROUGHOUT THE KILL ROOM. NO SINGLE JOB OR WORK LOCATION WAS CLEARLY ASSOCIATED WITH INCREASED RISK OF INFECTION.

B. ROUTE OF INFECTION

FOUR POSSIBLE ROUTES OF EXPOSURE TO BRUCELLA (AIRBORNE, CONTACT, CONJUNCTIVAL, AND INFECTION) WERE ASSESSED USING SEROPOSITIVITY AS AN INDEX OF INFECTION. THE STUDY POPULATION FOR THIS ASSESSMENT CONSISTED OF THOSE INDIVIDUALS WHO: 1) WERE PART OF THE RANDOM SURVEY SAMPLE, AND 2) HAD NOT WORKED IN THE BEEF KILL DEPARTMENT IN THE PRECEDING 12 MONTHS IF THEIR CURRENT JOB DID NOT REQUIRE WORK IN THAT AREA.

VENTILATION STUDIES INDICATED THAT EMPLOYEES IN BOTH STAGE I AND STAGE II PROCESSING AREAS OF THE KILL DEPARTMENT WERE EQUALLY EXPOSED TO ANY INFECTIOUS AEROSOLS POSSIBLE GENERATED IN THAT DEPARTMENT. HOWEVER, ADJACENT DEPARTMENTS RECEIVED ESSENTIALLY NO AIR FLOW FROM THE KILL ROOM. THEREFORE, EXPOSURE TO KILL ROOM AIR WAS BASED UPON THE DAILY AMOUNT OF TIME THAT EMPLOYEES WERE ACTUALLY PRESENT IN THE KILL ROOM WHILE THE PROCESSING LINE WAS IN OPERATION. INDIVIDUALS HAVING CONSIDERABLE AEROSOL EXPOSURE (MORE THAN 1 HOUR PER DAY) WERE PRIMARILY THOSE ASSIGNED TO THE KILL DEPARTMENT, WHILE EMPLOYEES WITH OCCASIONAL EXPOSURE (AVERAGING LESS THAN 1 HOUR PER DAY) INCLUDED MAINTENANCE EMPLOYEES AND FREQUENT VISITORS.

THE RATE OF SEROPOSITIVITY WAS SIGNIFICANTLY GREATER (FISHER'S EXACT TEST, 1-TAILED: $P = 0.0001$) IN EMPLOYEES WHO HAD EXPOSURE TO AIR IN THE BEEF KILL DEPARTMENT (29/68) THAN IN EMPLOYEES WHO DID NOT HAVE SUCH EXPOSURE (11/78) (TABLE 9). THE SEROPOSITIVITY RATE ALSO INCREASED IN PROPORTION TO DEGREE OF EXPOSURE (CHI SQUARE TEST FOR LINEAR TREND: $P < 0.0004$). EXCLUDING WORKERS ENGAGED IN STAGE I AND STAGE II PROCESSING OPERATIONS, A SIGNIFICANT ASSOCIATION WAS STILL FOUND BETWEEN SEROPOSITIVITY AND EXPOSURE TO AIR IN THE BEEF KILL DEPARTMENT (CHI SQUARE: $P < 0.02$). NONETHELESS, TEN (10) OF TWENTY-ONE (21) SEROPOSITIVE WORKERS IN THIS LATTER GROUP REPORTED NO SUCH EXPOSURE, AND TEN (10) HAD ONLY OCCASIONAL EXPOSURE.

THE ROLE OF CONTACT WAS ASSESSED BY COMPARING SEROPOSITIVITY WITH CONTACT COEFFICIENT (TABLE 10). PERSONS WITH A CONTACT COEFFICIENT ≤ 9 HAD A SIGNIFICANTLY LOWER SEROPOSITIVITY RATE (16/91) THAN PERSONS WITH A CONTACT COEFFICIENT ≥ 10 (24/55) (FISHER'S EXACT TEST, 1-TAILED: $P < 0.0007$). THERE WAS ALSO A SIGNIFICANT TREND TOWARD INCREASING CONTACT COEFFICIENT (CHI SQUARE TEST FOR LINEAR TREND: $P < 0.002$).

BECAUSE THE INJURY FACTOR USED IN DETERMINING THE CONTACT COEFFICIENT MAY HAVE BEEN UNDER-REPORTED, THE ROLE OF EXPOSURE WAS ALSO ASSESSED USING ONLY THE CONTACT FACTOR (TABLES 1 AND 11). THE SEROPOSITIVITY RATE IN PERSONS HAVING NO ANIMAL TISSUE CONTACT (6/43) WAS SIGNIFICANTLY LOWER THAN IN PERSONS WHO DID HAVE CONTACT (34/103) (FISHER'S EXACT TEST, 1-TAILED: $P = 0.013$). IN THE GROUP HAVING ANIMAL TISSUE

CONTACT, THE MEDIAN CONTACT FACTOR WAS 8. THE SEROPOSITIVITY RATE IN EMPLOYEES WITH A CONTACT FACTOR OF 1-7 (13/49) WAS NOT SIGNIFICANTLY DIFFERENT THAN IN THOSE WITH A CONTACT FACTOR OF 8-10 (21/54). HOWEVER, THE TREND TOWARD A POSITIVE ASSOCIATION BETWEEN SEROPOSITIVITY AND CONTACT-FACTOR FOUND IN TABLE 11 WAS STATISTICALLY SIGNIFICANT (CHI SQUARE DUE TO LINEAR TREND: $P < 0.01$).

THE POTENTIAL FOR CONJUNCTIVAL EXPOSURE WAS ASSESSED BY THE FREQUENCY WITH WHICH EMPLOYEES' FACES WERE SPLATTERED WITH ANIMAL TISSUE (TABLE 12). IN THE SAMPLE GROUP AS A WHOLE, SEROPOSITIVITY WAS SIGNIFICANTLY ASSOCIATED WITH ANY CONJUNCTIVAL EXPOSURE (OCCASIONAL AND CONSIDERABLE) (FISHER'S EXACT TEST, 1-TAILED: $P = 0.001$) SEROPOSITIVITY RATE AND FREQUENCY OF CONJUNCTIVAL EXPOSURE ALSO HAD A SIGNIFICANTLY POSITIVE ASSOCIATION (CHI SQUARE DUE TO LINEAR TREND: $P < 0.001$). HOWEVER, THIS WAS DUE TO THE HIGH FREQUENCY OF CONJUNCTIVAL EXPOSURE (31/33) AND SEROPOSITIVITY (16/33) IN STAGE II WORKERS. IF STAGE II WORKERS ARE EXCLUDED FROM THE ANALYSIS, THE CORRELATION BETWEEN CONJUNCTIVAL EXPOSURE AND SEROPOSITIVITY IS NOT SIGNIFICANT.

INGESTION OF POTENTIALLY INFECTIOUS MEAT OR MEAT PRODUCTS DID NOT APPEAR TO HAVE A ROLE IN THE EPIDEMIC. ONLY ELEVEN (11) WORKERS (8%) IN THE RANDOM SAMPLE GROUP REPORTED POTENTIAL EXPOSURE VIA THIS ROUTE, AND ONLY READY-TO-EAT PRODUCTS, SUCH AS SAUSAGE, WERE REPORTED AS BEING EATEN (TABLE 13).

c. PROTECTIVE EQUIPMENT

WHETHER PROTECTIVE EQUIPMENT AND CLOTHING, COMMONLY USED IN ABATTOIRS, HAD ANY INFLUENCE ON RISK OF BRUCELLA INFECTION WAS EVALUATED IN THE SAME STUDY POPULATION USED TO EVALUATE ROUTE OF INFECTION. ITEMS EVALUATED WERE RUBBER GLOVES, RUBBER APRONS, COVER-ALLS, MESH GLOVES AND GLASSES.

WITH THE EXCEPTION OF COVER-ALLS, NO SIGNIFICANT DIFFERENCE WAS OBSERVED IN SEROPOSITIVITY RATES BETWEEN PERSONS WEARING OR NOT WEARING ANY OF THESE ITEMS (TABLE 14). THE APPARENT PROTECTIVE EFFECT OF COVER-ALLS WAS DUE TO THE HIGH FREQUENCY WITH WHICH THIS CLOTHING ITEM WAS WORN IN LOW-RISK STAGE III PROCESSING AREAS COMPARED WITH HIGHER RISK AREAS. THE APPARENT PROTECTIVE EFFECT IN STAGE III WORKERS WAS SIGNIFICANT (FISHER'S EXACT TEST, 1-TAILED: $P = 0.021$); THE DISPARATE SEROPOSITIVITY RATE IN WORKERS WHO DID NOT WEAR COVER-ALLS WAS DUE TO THE HIGH SEROPOSITIVITY RATE IN THE HIDE DEPARTMENT. ALTHOUGH CONSIDERED A STAGE III OPERATION, THE HIDE DEPARTMENT RECEIVED RAW HIDES DIRECTLY FROM THE BEEF KILL DEPARTMENT. NONE OF THE THREE (3) WORKERS IN THIS DEPARTMENT, WHO WERE INCLUDED IN THE SAMPLE, WORE COVER-ALLS AND ALL THREE (3) WERE SEROPOSITIVE. IF THIS HIGH RISK DEPARTMENT IS EXCLUDED FROM THE ANALYSIS, NO PROTECTIVE EFFECT FROM THE WEARING OF COVER-ALLS COULD BE DEMONSTRATED FOR STAGE III.

EVALUATION DISCUSSION

ALTHOUGH A LIMITED NUMBER OF CASES HAD OCCURRED PREVIOUSLY, THE INCIDENCE OF BRUCELLOSIS IN PEYTON PACKING COMPANY EMPLOYEES ASSUMED EPIDEMIC PRO-

PORTIONS IN THE PERIOD JUNE, 1975 - AUGUST, 1976. THE EPIDEMIC RESULTED FROM SLAUGHTERING BRUCELLA -INFECTED CATTLE, WITH THE GREATEST RISK OF INFECTION OCCURRING IN THE BEEF KILL DEPARTMENT AND THOSE DEPARTMENT RECEIVING UNCHILLED ANIMAL BY-PRODUCTS DIRECTLY FROM THE BEEF KILL DEPARTMENT.

THE EPIDEMIC APPEARED TO BE RELATED TO AN INCREASE IN THE NUMBER OF CATTLE, PARTICULARLY BULLS AND COWS, SLAUGHTERED. HOWEVER, THE EPIDEMIC CURVE DID NOT CORRELATE WELL WITH THE NUMBER OF BRUCELLA REACTOR CATTLE SLAUGHTERED. BECAUSE ONLY COWS AND BULLS ARE ROUTINELY SCREENED FOR SEROLOGIC EVIDENCE OF INFECTION, THIS SUGGESTS UNDETECTED BRUCELLOSIS IN YOUNGER BEEF CATTLE (HEIFERS AND STEERS) MAY HAVE BEEN AN IMPORTANT SOURCE OF INFECTION FOR PLANT EMPLOYEES. IT MAY ALSO INDICATE THAT SEROPOSITIVITY RATES IN SLAUGHTER CATTLE ARE NOT A RELIABLE MEASURE OF POTENTIAL RISK TO ABATTOIR WORKERS.

WITH THE EXCEPTION OF INGESTION, WHICH APPEARED TO HAVE NO SIGNIFICANCE, THE RELATIVE IMPORTANCE OF THE VARIOUS POSSIBLE ROUTES OF INFECTION WAS UNCERTAIN. INFECTION, AS MEASURED BY SEROPOSITIVITY, WAS SIGNIFICANTLY ASSOCIATED WITH THREE COMMONLY RECOGNIZED ROUTES OF INFECTION (CONTACT, AIRBORNE, AND CONJUNCTIVAL EXPOSURE). INFECTION WAS DETECTED IN PERSONS HAVING NO, OR MINIMAL, EXPOSURE TO EACH INDIVIDUAL ROUTE. OF FORTY (40) SEROPOSITIVE WORKERS IN THE SAMPLE GROUP, ELEVEN (11) REPORTED NO EXPOSURE TO AIR IN THE BEEF KILL DEPARTMENT, SIX (6) NO CONTACT WITH ANIMAL TISSUES, AND TEN (10) NO CONJUNCTIVAL EXPOSURE TO POTENTIALLY INFECTIOUS MATERIALS. BUT, ALL SEROPOSITIVE WORKERS REPORTED EXPOSURE BY AT LEAST ONE POTENTIAL ROUTE OF INFECTION WITH TWO EXCEPTIONS. THESE TWO INDIVIDUALS WERE MAINTENANCE WORKERS WHO REPAIRED MACHINERY THROUGHOUT THE PLANT, AND IT IS PROBABLE THAT THEY BOTH HAD CONTACT WITH POTENTIALLY INFECTIOUS MATERIAL DUE TO THE NATURE OF THEIR WORK.

MORE THAN ONE ROUTE OF INFECTION WAS PROBABLY INVOLVED. THIS IS PARTICULARLY TRUE IN THE BEEF KILL DEPARTMENT WHERE VIRTUALLY ALL EMPLOYEES HAD AEROSOL, CONTACT, AND CONJUNCTIVAL EXPOSURE.

AT THE PRESENT TIME, LITTLE CAN BE DONE TO PREVENT BRUCELLOSIS IN ABATTOIR WORKERS. BRUCELLOSIS IS ENDEMIC IN DOMESTIC CATTLE AND SWINE. A NATIONAL BRUCELLOSIS ERADICATION PROGRAM HAS BEEN IN PROGRESS FOR MANY YEARS, BUT WHEN, AND IF, ERADICATION WILL BE ACHIEVED IS UNCERTAIN.

PRE-SLAUGHTER SEROLOGIC SCREENING OF CATTLE AND EITHER REFUSAL TO SLAUGHTER OR SLAUGHTERING REACTOR CATTLE WITH SPECIAL PRECAUTIONS WOULD BE AN EXTREMELY COSTLY APPROACH TO THE PROBLEM. ALSO, THE SEROLOGIC TESTS CURRENTLY USED MAY FAIL TO DETECT AS MUCH AS 40% OF INFECTED COWS AND BULLS. THE SENSITIVITY OF THESE TESTS IN DETECTING INFECTED HEIFERS AND STEERS IS EVEN LOWER.

IT WAS NOT POSSIBLE TO DEMONSTRATE ANY PROTECTION AGAINST INFECTION BY PROTECTIVE CLOTHING AND EQUIPMENT COMMONLY USED IN ABATTOIRS. MESH GLOVES PROTECT AGAINST MORE SERIOUS CUTS, BUT MINOR SCRATCHES AND ABRASIONS PROVIDE EQUALLY EFFECTIVE PORTALS OF ENTRY FOR BRUCELLA ORGANISMS. RUBBER GLOVES, THEORETICALLY, PROVIDE PROTECTION AGAINST CONTACT EXPOSURE. THE TYPE OF GLOVES USED, HOWEVER, DO NOT PREVENT EXPOSURE TO WRISTS AND FOREARMS, AND BLOOD AND OTHER POTENTIALLY INFECTIOUS MATERIALS FREQUENTLY ENTER THE GLOVES THROUGH THE OPEN END OF THE GLOVE AND ACCIDENTAL PERFORATIONS.

IF THE CONJUNCTIVAL ROUTE OF INFECTION IS OF IMPORTANCE, ORDINARY EYE GLASSES DID NOT APPEAR TO PROVIDE PROTECTION. FACE SHIELDS OR GOGGLES MIGHT BE MORE EFFECTIVE, BUT REQUIRING THEIR USE WOULD BE BASED ON THEORETICAL GROUNDS ONLY.

SOME REDUCTION IN BRUCELLOSIS RESULTING FROM EXPOSURE TO INFECTIOUS AEROSOLS GENERATED IN THE KILL DEPARTMENT COULD BE ACHIEVED BY RESTRICTING ENTRY INTO THIS AREA. THE ORIGIN OF SUCH AEROSOLS ON THE KILL FLOOR IS UNCERTAIN, AND MULTIPLE PROCESSING OPERATIONS MAY BE RESPONSIBLE. IT IS DOUBTFUL WHETHER ANY REDUCTION OF BRUCELLOSIS COULD BE ACHIEVED ON THE KILL FLOOR ITSELF THROUGH CHANGING AIR-FLOW PATTERNS OR OTHER METHODS OF AEROSOL CONTROL. EVEN IF AEROSOL EXPOSURE COULD BE TOTALLY ELIMINATED, BEEF KILL DEPARTMENT EMPLOYEES WOULD STILL HAVE SIGNIFICANT CONTACT AND CONJUNCTIVAL EXPOSURE.

AT THE PRESENT TIME, AEROSOLS GENERATED IN THE BEEF KILL DEPARTMENT DO NOT ENTER OTHER PROCESSING AREAS OF THE PLANT. BECAUSE OF THE POTENTIALLY INFECTIOUS NATURE OF THESE AEROSOLS, ANY FUTURE MODIFICATION OF THE PLANT MUST BE DESIGNED TO CONTINUE THIS PATTERN.

ALTHOUGH A VACCINE IS NOT AVAILABLE FOR HUMAN BRUCELLOSIS, RECOVERY FROM BRUCELLOSIS IS ASSOCIATED WITH IMMUNITY AGAINST REINFECTION IN ABOUT 90% OF PATIENTS. SELECTIVE ASSIGNMENT OF EMPLOYEES WHO HAVE RECOVERED FROM BRUCELLOSIS TO HIGH RISK WORK DEPARTMENTS COULD REDUCE THE NUMBER OF POTENTIALLY SUSCEPTIBLE WORKERS IN THESE AREAS. WHETHER THIS WOULD BE ACCEPTABLE TO THE INVOLVED WORKERS IS OPEN TO QUESTION.

EARLY DIAGNOSIS AND APPROPRIATE THERAPY WILL REDUCE THE IMPACT OF BRUCELLOSIS ON PATIENTS AS MEASURED BY DURATION AND SEVERITY OF ILLNESS AND FREQUENCY OF COMPLICATIONS. THE DETECTION OF PREVIOUSLY UNDIAGNOSED CASES IN THE 2 SURVEYS INDICATED THAT CURRENT CASE-DETECTION PROCEDURES NEED IMPROVEMENT.

ALL WORKERS AND SUPERVISORS SHOULD BE INFORMED OF HOW BRUCELLOSIS IS ACQUIRED, ITS SYMPTOMS, AND THE NEED FOR PROMPT DIAGNOSIS AND TREATMENT. AN EDUCATIONAL PROGRAM OF THIS TYPE SHOULD BE AN ON-GOING EFFORT AND SHOULD BE CONDUCTED IN BOTH ENGLISH AND SPANISH. POSTERS IN ENGLISH AND SPANISH DESCRIBING THE DISEASE AND WHERE TO GO FOR DIAGNOSIS AND TREATMENT SHOULD BE PERMANENTLY PLACED ON BULLETIN BOARDS IN LOCATIONS WHERE EMPLOYEES ARE LIKELY TO READ THEM.

A NURSE SHOULD BE EMPLOYED TO SERVE AS A FOCAL POINT FOR MEDICAL CASE AT THE PLANT. THE NURSE SHOULD BE RESPONSIBLE FOR TREATMENT OF MINOR ILLNESSES AND INJURIES, PRIMARY SCREENING AND REFERRAL OF MORE SERIOUS MEDICAL PROBLEMS, AND MAINTENANCE OF EMPLOYEE MEDICAL RECORDS. AT THE TIME OF THE AUGUST, 1976, HEALTH HAZARD EVALUATION, THE ONLY READILY AVAILABLE MEDICAL CARE FOR THE PLANT EMPLOYEES WAS FIRST-AID ADMINISTERED BY OFFICE PERSONNEL, AND MEDICAL RECORDS WERE NOT BEING MAINTAINED.

BECAUSE OF THE DOCUMENTED RISK OF BRUCELLOSIS, THE DISEASE SHOULD BE ROUTINELY CONSIDERED IN THE DIFFERENTIAL DIAGNOSIS OF FEBRILE ILLNESSES IN PLANT EMPLOYEES. ALL EMPLOYEES HAVING FEVER OF UNKNOWN ORIGIN LASTING MORE THAN THREE (3) DAYS SHOULD BE APPROPRIATELY EVALUATED, INCLUDING SEROLOGY AND BLOOD CULTURE, FOR POSSIBLE BRUCELLOSIS.

2. ENVIRONMENTAL

RESULTS OF VENTILATION STUDIES REVEALED THAT WORKERS IN THE PROCESSING

AREAS OF THE KILL DEPARTMENT WERE EQUALLY EXPOSED TO ANY INFECTIOUS AEROSOLS GENERATED IN THAT AREA. ADJACENT DEPARTMENTS/WORK AREAS RE-REIVED ESSENTIALLY NO AIR FLOW FROM THE KILL ROOM. ANY FUTURE MODIFICATION OF PLANT OPERATIONS MUST INSURE THAT NO BASIC CHANGES IN THAT CONDITION OCCUR.

V. RECOMMENDATIONS

OTHER THAN REDUCING UNNECESSARY EXPOSURE OF EMPLOYEES TO INFECTIOUS AEROSOLS GENERATED IN THE BEEF KILL DEPARTMENT, LITTLE CAN BE DONE ON A PRACTICAL BASIS TO PREVENT BRUCELLA INFECTIONS IN PEYTON PACKING COMPANY EMPLOYEES. MORE EMPHASIS, HOWEVER, SHOULD BE PLACED ON DETECTION AND APPROPRIATE THERAPY OF CASES. BASED ON THE FINDINGS OF THIS STUDY, IT IS RECOMMENDED:

1. THAT ENTRY TO THE BEEF KILL DEPARTMENT BE RESTRICTED TO ESSENTIAL OPERATING PERSONNEL.

2. THAT NO FUTURE MODIFICATIONS BE MADE IN THE PLANT WHICH WOULD RESULT IN AEROSOLS GENERATED IN THE BEEF KILL DEPARTMENT ENTERING OTHER WORK AREAS.

3. THAT EMPLOYEES WHO HAVE RECOVERED FROM BRUCELLOSIS BE SELECTIVELY ASSIGNED TO HIGH RISK AREAS, IF ACCEPTABLE TO THE INDIVIDUAL EMPLOYEE.

4. THAT EMPLOYEES AND SUPERVISORS BE INSTRUCTED IN HOW BRUCELLOSIS IS ACQUIRED, ITS SYMPTOMS, AND THE NEED FOR PROMPT DIAGNOSIS AND THERAPY. AN EDUCATIONAL PROGRAM OF THIS TYPE SHOULD BE CONDUCTED IN BOTH ENGLISH AND SPANISH.

5. THAT POSTERS IN ENGLISH AND SPANISH DESCRIBING THE DISEASE AND WHERE TO GO FOR DIAGNOSIS AND TREATMENT SHOULD BE PERMANENTLY PLACED ON BULLETIN BOARDS IN LOCATIONS WHERE EMPLOYEES ARE LIKELY TO READ THEM.

6. THAT A NURSE SHOULD BE EMPLOYED TO SERVE AS A FOCAL POINT FOR MEDICAL CARE AT THE PLANT.

7. THAT BRUCELLOSIS BE ROUTINELY CONSIDERED IN THE DIFFERENTIAL DIAGNOSIS OF FEBRILE ILLNESSES IN PLANT EMPLOYEES. ALL EMPLOYEES HAVING FEVER OF UNKNOWN ORIGIN LASTING MORE THAN THREE (3) DAYS SHOULD BE APPROPRIATELY EVALUATED, INCLUDING SEROLOGY AND BLOOD CULTURE, FOR POSSIBLE BRUCELLOSIS.

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Table 1. Determination of contact factor for calculating the contact coefficient.

Contact Factor	Type of Meat Product Handled			Area of Body Having Contact			Percent of Work Time in Contact		
	Freshly Killed	Chilled	Cured or Cooked	Hands		Hands, Wrists and Forearms	<25%	25-75%	>75%
10	X					X			X
9	X			X					X
8		X		X	or	X			X
7	X					X		X	
6		X				X		X	
5	X			X				X	
4		X		X				X	
3	X			X			X		
2		X		X	or	X	X		
1			X	X	or	X	X	or X or	X
0	(None)								

Table 2. Signs and Symptoms in 46 brucellosis cases by diagnostic category, Peyton Packing Company, El Paso, Texas, December 1968 - August 1976.

Symptoms	Confirmed N = 11	Presumptive N = 28	Suspected N = 7	Total N = 46
Body Aches	10 (91%)	28 (100%)	6 (86%)	44 (96%)
Weakness	11 (100%)	27 (96%)	5 (72%)	43 (93%)
Fever	11 (100%)	27 (96%)	5 (72%)	43 (93%)
Chills	11 (100%)	27 (96%)	5 (72%)	43 (93%)
Malaise	9 (82%)	27 (96%)	6 (86%)	42 (91%)
Diaphoresis	10 (91%)	25 (89%)	4 (57%)	39 (85%)
Headache	8 (73%)	21 (75%)	6 (86%)	35 (76%)
Loss of Weight	11 (100%)	20 (71%)	1 (14%)	32 (70%)
Anorexia	8 (73%)	18 (64%)	2 (29%)	28 (61%)
Stomach Cramps	3 (27%)	8 (28%)	3 (43%)	14 (30%)
Epistaxis	3 (27%)	6 (21%)	1 (14%)	10 (22%)
Ear Aches	2 (18%)	4 (14%)	1 (14%)	7 (15%)
Loss of Memory		1 (4%)		1 (2%)
Anxiety	1 (9%)			1 (2%)
Intraocular Pain		1 (4%)		1 (2%)
Testicular Pain	1 (9%)			1 (2%)

Table 3 Brucellosis attack rate by department, Peyton Packing Company, El Paso, Texas, July 1975 - August 1976

Department	Attack Rate
Stage I Operations	
Beef Kill	1/6 (17%)*
Stage II Operations	
Beef Kill	24/76 (32%)
Edible Rendering	0/1 (0%)
Inedible Rendering	2/5 (40%)
Total Stage II	26/82 (32%)
Stage III Operations	
Beef Cooler	1/24 (1%)
Beef Fabrication	3/70 (4%)
Curing	1/16 (6%)
Hides	1/8 (13%)
Offal	2/7 (29%)
Sausage Manufacturing	1/18 (6%)
Other	0/90 (0%)
Total Stage III	9/233 (4%)
Mixed Operations	
Janitorial	2/15 (13%)
Maintenance	5/22 (23%)
Store Room	0/3 (0%)
Total Mixed	7/40 (18%)
Non-Processing Operations	
Shipping	1/2 (50%)
Other	0/101 (0%)
Total Non-Processing	1/103 (1%)
Total All Operations	44/464 (9%)

*No. confirmed, presumptive, suspected cases/ estimated no. employees at risk (%).

Table 4 Brucellosis attack rates by operational category and plant seniority, Peyton Packing Company, El Paso, Texas, July 1975 - August 1976*.

Operational Category	Number years plant seniority			Total
	< 1	1 - 4	5 - 9	
Stage I		1/3 (33%)**	0/3 (0%)	1/6 (17%)
Stage II	8/10 (80%)	8/26 (31%)	10/45 (22%)	26/81 (32%)
Stage III	1/3 (33%)	3/33 (9%)	5/107(5%)	9/143 (6%)
Mixed	0/1 (0%)	5/11 (45%)	2/25 (8%)	7/37 (19%)
Non-Processing			1/2 (50%)	1/2 (50%)
Total	9/14 (64%)	17/73 (23%)	18/182(10%)	44/269 (16%)

* Excluding employees of departments where brucellosis cases did not occur.

**No. cases/No. employees (%)

Table 5. Brucellosis infection rate in cattle, Arizona, New Mexico, Texas, Fiscal Years 1973-1976

	Fiscal Year			
State	1973	1974	1975	1976
Arizona	16.4*	13.8	39.3	32.3
New Mexico	79.4	51.4	54.0	104.4
Texas	254.8	260.7	231.0	241.0

*Cattle infection rate per 10,000 animals tested based on total cattle tested on farm, Market Cattle Tests, and Brucellosis Ring Test negative tests adjusted for frequency.

e 6. Brucella antibody titers in 182 employee prior history of brucellosis, Peyton Packing any, El Paso, Texas, August 1976.

Clinical History	CA* Titer ≥ 1:160			CA Titer ≤ 1:80		
	2ME-CA** titer ≥ 1:20	2ME-CA titer < 1:20	Total	2ME-CA titer ≥ 1:20	2ME-CA titer < 1:20	Total
Brucellosis						
≤ 6 months previously	12	6	18	0	2	2
7 - 12 months previously	11	4	15	1	1	2
> 12 months previously	0	0	0	2	0	2
Sub-total	23	10	33	3	3	6
No Brucellosis	17	6	23	0	120	120
Total	40	16	56	3	123	126

* CA = centrifugation-agglutination

**2ME-CA = 2-mercaptoethanol degradation centrifugation-agglutination

Table 7. Brucella seropositivity rate by department, Peyton Packing Company, El Paso, Texas, August 1976.

Department	Seropositivity Rate	Seropositivity Rate Excluding Persons with Prior Beef Kill Exposure*
Stage I Operations		
Beef Kill**	3/6 (50%)***	3/6 (50%)
Stage II Operations		
Beef Kill**	14/29 (48%)	14/29 (48%)
Edible Rendering	0/1 (0%)	0/1 (0%)
Inedible Rendering**	2/3 (67%)	2/3 (67%)
Total Stage Ii	16/33 (48%)	16/33 (48%)
Stage III Operations		
Beef Cooler**	0/4 (0%)	0/4 (0%)
Beef Fabrication**	2/11 (18%)	1/9 (11%)
Curing**	1/6 (17%)	1/6 (17%)
Hides**	4/4 (100%)	3/3 (100%)
Offal**	2/6 (33%)	2/6 (33%)
Sausage Mfg.**	1/11 (9%)	0/10 (0%)
Sausage Slice	2/9 (22%)	1/7 (14%)
Shipping	1/10 (10%)	0/7 (0%)
Other	0/23 (0%)	0/21 (0%)
Total Stage III	13/84 (15%)	8/73 (11%)
Mixed Operations		
Janitorial**	2/7 (28%)	2/7 (28%)
Maintenance**	9/15 (60%)	9/15 (60%)
Store Room	1/2 (50%)	1/2 (50%)
Total Mixed	12/24 (50%)	12/24 (50%)
Non-Processing Operations		
Shipping**	1/2 (50%)	1/2 (50%)
Garage	1/1 (100%)	0/0 (0%)
Other	0/8 (0%)	0/8 (0%)
Total Non-Processing	2/11 (18%)	1/10 (10%)
Total All Operations	46/158(29%)	40/146(27%)

* Excluding persons who worked in beef kill department in the preceding 12 months and are currently employed in another department where exposure to the beef kill department is not required.

** Departments where brucellosis cases occurred in the preceding 12 months.

***No. having centrifugation-agglutination titer $\geq$1:160/No. tested in random survey (%).

Table 8. Brucellosis seropositivity rates by operational category and seniority, Peyton Packing Company, El Paso, Texas, August 1976*

Operational Category	Number Years Departmental Seniority				Number Years Plant Seniority			
	< 1	1 - 4	5 - 9	Total	< 1	1 - 4	5 - 9	Total
Stage I		2/3 (67%)	1/3 (33%)	3/6 (50%)		2/3 (67%)	1/3 (33%)	3/6 (50%)
Stage II	1/1 (100%)	6/11(55%)	9/21(43%)	16/33 (48%)		4/5 (80%)	12/28 (43%)	16/33 (48%)
Stage III	0/4 (0%)	6/12(50%)	2/15(13%)	8/31 (26%)		3/5 (60%)	5/26 (19%)	8/31 (26%)
Mixed		5/9 (55%)	7/15(47%)	12/24 (50%)		5/9 (55%)	7/15 (47%)	12/24 (50%)
Non-Processing		1/1 (100%)	0/1 (0%)	1/2 (50%)			1/2 (50%)	1/2 (50%)
Total	1/5 (20%)	20/36(56%)	19/55(35%)	40/96 (42%)		14/22 (64%)	26/74 (35%)	40/96 (42%)

* Excluding departments having no seropositive employees and those stage III and non-processing employees who worked in the beef kill department in the preceding 12 months.

**No. persons having a centrifugation-agglutination titer $\geq$ 1:160/No. tested (%).

Table 9 Brucella seropositivity rate by operational category and exposure to kill room air, Peyton Packing Company, El Paso, Texas, August 1976

Operational Category*	Exposure to Kill Room Air: None	Occasional (0-1 hr/day)	Considerable (> 1 hr/day)	Total
Stage I		1/2 (50%)**	2/4 (50%)	3/6 (50%)
Stage II	1/1 (100%)	2/3 (67%)	13/29 (46%)	16/33 (48%)
Stage III	5/60 (8%)	3/12 (25%)	0/1 (0%)	8/73 (11%)
Mixed	5/11 (45%)	6/10 (60%)	1/3 (33%)	12/24 (50%)
Non-processing	0/6 (0%)	1/4 (25%)		1/10 (10%)
Total	11/78 (14%)	13/31 (42%)	16/37 (43%)	40/146(27%)

* Excludes persons who worked in the beef kill department in the preceding 12 months and whose current job does not require work in that area.
**No. having centrifugation-agglutination titer $\geq$ 1:160/No. tested (%).

Table 10 Brucella seropositivity rate by operational category and degree of animal tissue contact, Peyton Packing Company, El Paso, Texas, August 1976.

Operational Category*	Contact Coefficient 0 - 9	10 - 29	30 - 50	Total
Stage I	2/4 (50%)**	0/1 (0%)	1/1 (100%)	3/6 (50%)
Stage II	1/1 (100%)	10/24 (42%)	5/8 (63%)	16/33 (48%)
Stage III	5/61 (8%)	3/8 (38%)	0/4 (0%)	8/73 (11%)
Mixed	7/15 (47%)	4/7 (57%)	1/2 (50%)	12/24 (50%)
Non-Processing	1/10 (10%)			1/10 (10%)
Total	16/91 (18%)	17/40 (43%)	7/15 (47%)	40/146(27%)

* Excludes persons who worked in the beef kill department in the preceding 12 months and whose current job does not require work in that area.
**No. having centrifugation-agglutination titer $\geq$ 1:160/No. tested (%).

Table 11 Brucella seropositivity rate by operational category and contact factor, Peyton Packing Company, El Paso, Texas, August 1976

Operational Category**	Contact Factor* 0	1 - 7	8 - 10	Total
Stage I	1/2 (50%)***	1/2 (50%)	1/2 (50%)	3/6 (50%)
Stage II	1/2 (50%)	0/1 (0%)	15/30 (50%)	16/33 (48%)
Stage III	1/26 (4%)	3/28 (11%)	4/19 (21%)	8/73 (11%)
Mixed	3/7 (43%)	8/14 (57%)	1/3 (33%)	12/24 (50%)
Non-Processing	0/6 (0%)	1/4 (25%)		1/10 (10%)
Total	6/43 (14%)	13/49 (27%)	21/54 (39%)	40/146(27%)

* Median contact factor for employees reporting contact with animal tissues was 8.

** Excludes persons who worked in the beef kill department in the preceding 12 months and whose current job does not require work in that area.

***No. having centrifugation-agglutination titer $\geq$ 1:160/No. tested (%).

Table 12 Brucella seropositivity rate by operational category and conjunctival exposure to potentially infectious materials, Peyton Packing Company, El Paso, Texas, August 1976

Operational Category*	None	Occasional (Face splattered < once/week)	Considerable (Face splattered > once/week	Total
Stage I	1/1 (100%)**	1/1 (100%)	1/4 (25%)	3/6 (50%)
Stage II	0/1 (0%)		16/32 (50%)	16/33 (48%)
Stage III	5/50 (10%)	0/9 (0%)	3/14 (21%)	8/73 (11%)
Mixed	3/7 (43%)	3/6 (50%)	6/11 (55%)	12/24 (50%)
Non-processing	1/9 (11%)		0/1 (0%)	1/10 (10%)
Total	10/68 (15%)	4/16 (25%)	26/62 (42%)	40/146(27%)

* Excludes persons who worked in the beef kill department in the preceding 12 months and whose current job does not require work in that area.

**No. having centrifugation-agglutination titer $\geq$ 1:160/No. tested (%).

Table 13 Brucella seropositivity rate by operational category and frequency of eating meat products from the processing line, Peyton Packing Company, El Paso, Texas, August 1976.

Operational Category*	Frequency of Eating			
	None	Occasional (<once/week)	Considerable (>once/week)	Total
Stage I	3/6 (50%)**			3/6 (50%)
Stage II	15/31 (48%)	1/2 (50%)		16/33 (48%)
Stage III	8/66 (12%)	0/4 (0%)	0/3 (0%)	8/73 (11%)
Mixed	12/24 (50%)			12/24 (50%)
Non-processing	1/8 (13%)	0/1 (0%)	0/1 (0%)	1/10 (10%)
Total	39/135(29%)	1/7 (14%)	0/4 (0%)	40/146 (27%)

* Excludes persons who worked in the beef kill department in the preceding 12 months and whose current job does not require work in that area.
**No. having centrifugation-agglutination titer $\geq$ 1:160/No. tested (%).

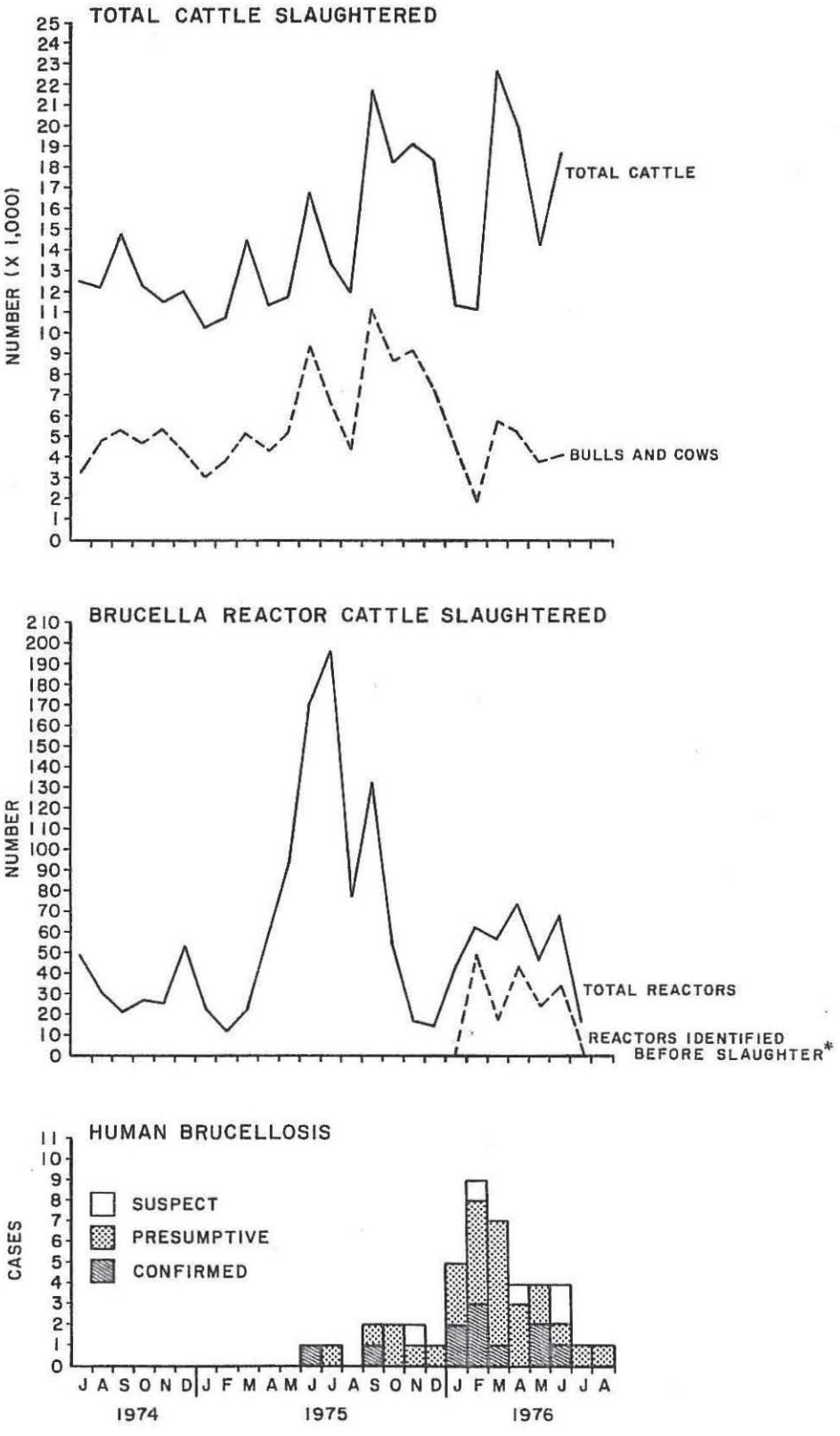
Table 14 Brucella seropositivity rate by operational category and the use of protective equipment and clothing, Peyton Packing Company, El Paso, Texas, August 1976

Protective Item	Item Worn	Operational Category*					
		Stage I	Stage II	Stage III	Mixed	Non-Processing	Total
Rubber gloves	Yes	0/0**	3/3	2/17	3/9	1/2	9/31
	No	3/6	13/30	6/56	9/15	0/8	31/115
Mesh gloves	Yes	0/0	3/6	1/9	0/0	0/0	4/15
	No	3/6	13/27	7/64	12/24	1/10	36/131
Rubber apron	Yes	2/4	14/29	5/39	3/8	0/0	24/80
	No	1/2	2/4	3/34	9/16	1/10	16/66
Cover-alls	Yes	1/1	2/5	4/61	2/2	1/5	10/74
	No	2/5	14/28	4/12	10/22	0/5	30/72
Glasses	Yes	0/1	4/5	3/14	8/18	1/2	16/40
	No	3/5	12/28	5/59	4/6	0/8	24/106

* Excludes persons who worked in the beef kill department in the preceding 12 months and whose current job does not require work in that area

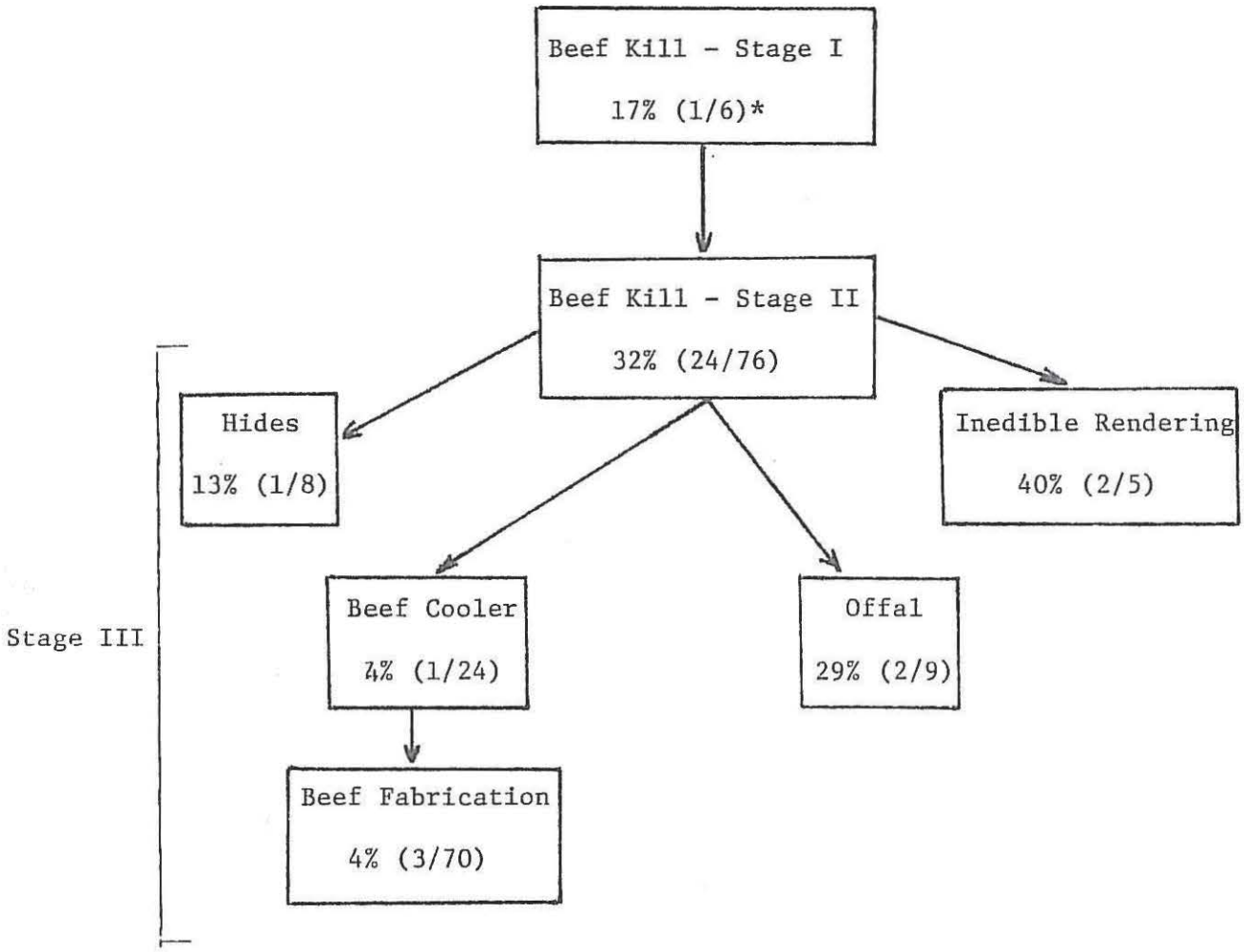
**No. having centrifugation-agglutination titer $\geq$ 1:160/No. tested.

Fig. 1 HUMAN BRUCELLOSIS CASES, CATTLE SLAUGHTERED, AND BRUCELLA REACTOR CATTLE SLAUGHTERED, BY MONTH, PEYTON PACKING COMPANY, EL PASO, TEXAS, JULY 1974 - AUGUST 1976



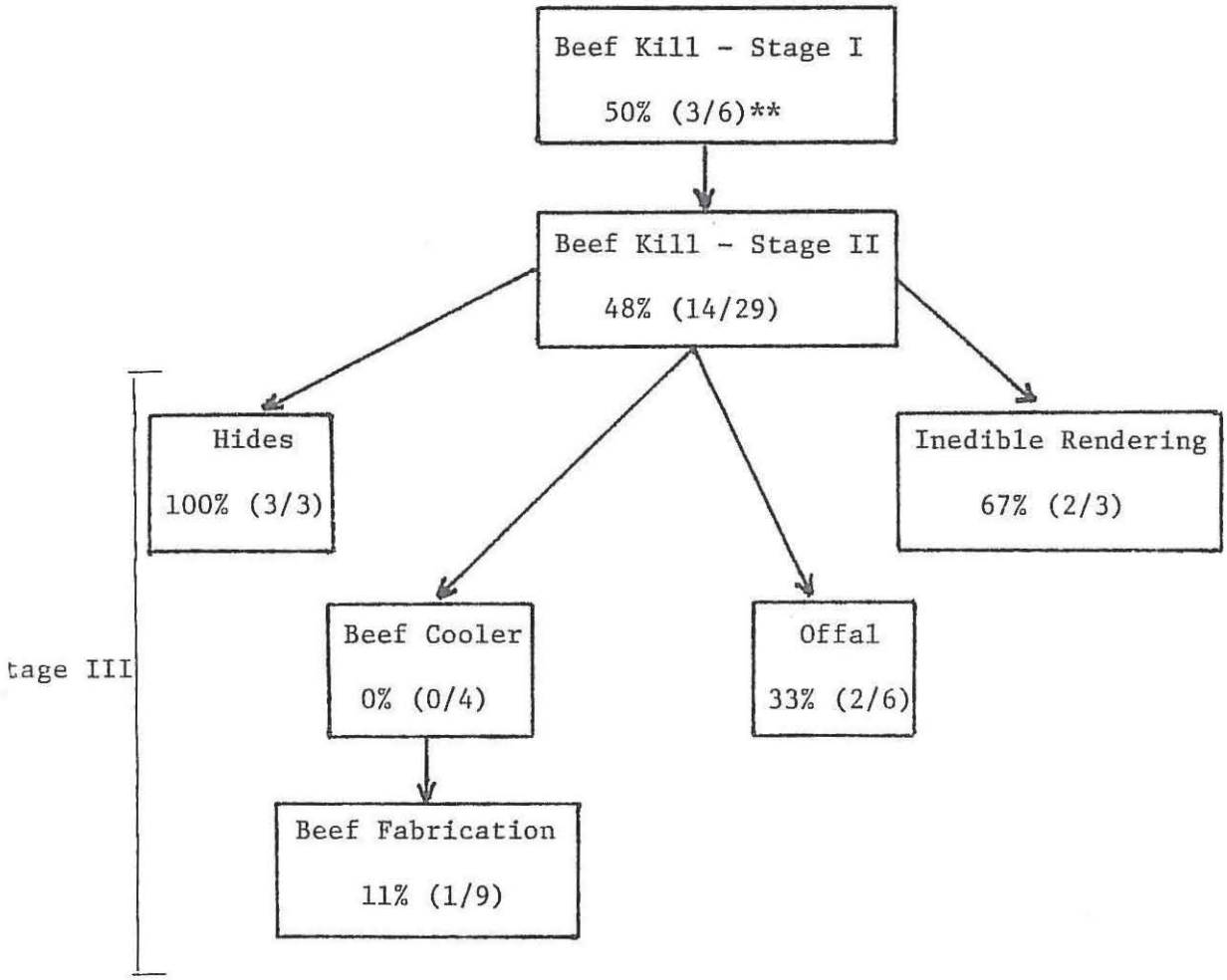
*DATA AVAILABLE ONLY FOR PERIOD JANUARY - JULY 1976

Fig. 2 Brucellosis attack rate in beef processing employees by work area, Peyton Packing Company, El Paso, Texas, July 1975 - August 1976



* Attack Rate % (No. Cases/Estimated No. Employees)

Fig. 3 Brucella seropositivity rate in beef processing employees by work area, Peyton Packing Company, El Paso, Texas, August 1976*



* Excluding persons who worked in the beef kill department in the preceding 12 months and are currently employed in another department where exposure to the beef kill department is not required

**% seropositive (No. having centrifugation-agglutination titer $\geq$ 1:160/ No. tested)