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Research and Development

**ERLGB PUBLICATIONS AND ABSTRACTS
RELATED TO BIOTECHNOLOGY :**

**II. BIORATIONAL , MICROBIAL AND
BIOCHEMICAL CONTROL AGENTS**

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COUCH, J.A., S.M. MARTIN, G. TOMPKINS, AND J. KINNEY. IN PRESS. SIMPLE SYSTEM FOR THE PRELIMINARY EVALUATION OF INFECTIVITY AND PATHOGENESIS OF INSECT VIRUS IN A NONTARGET ESTUARINE SHRIMP. J. INVERTEBR. PATHOL. (ERL,GB 460).

BIOLOGICAL CONTROL AGENTS (BIORATIONALS) ARE INCREASINGLY IMPORTANT IN PEST CONTROL CONCEPTS. CERTAIN INSECT VIRUSES, PARTICULARLY THE BACULOVIRUSES (NUCLEAR POLYHEDROSIS VIRUSES), ARE CONSIDERED TO HAVE POTENTIAL AS BIOLOGICAL PESTICIDES, AND COULD BE USED WIDELY IN THE ENVIRONMENT. THEREFORE, TEST ANIMALS MUST BE SELECTED AND METHODS DEVELOPED TO EVALUATE THE SAFETY OF BIORATIONALS TO NON-TARGET SPECIES. A SIMPLE LABORATORY SYSTEM HAS BEEN DESIGNED AND TESTED TO DETERMINE RISKS OF INFECTIVITY AND PATHOGENICITY OF AN INSECT BACULOVIRUS, ORIGINALLY ISOLATED FROM THE ALFALFA LOOPER AUTOGRAPHA CAILFORNICA, TO A NON-TARGET ARTHROPOD, THE GRASS SHRIMP, PALAEMONETES VULGARIS, BY DIETARY EXPOSURE. THIS LABORATORY METHOD ALSO PERMITS TESTING OF OTHER MICROBIAL BIORATIONALS AGAINST NON-TARGET AQUATIC SPECIES, AND PROVIDES AN INEXPENSIVE, PROCEDURE OF SAFETY TESTING. RESULTS FROM THIS STUDY INDICATED THAT HISTOPATHOLOGICAL, ULTRASTRUCTURAL AND SEROLOGICAL METHODS USED PROVIDED NO EVIDENCE THAT EXPERIMENTAL EXPOSURE TO THE VIRUS CAUSED VIRAL INFECTION OR RELATED PATHOGENICITY IN THE GRASS SHRIMP.

COUCH, JOHN. 1975. DISCUSSION FROM SELECTED PAPERS PRESENTED AT EPA-USDA WORKING SYMPOSIUM. IN: BACULOVIRUSES FOR INSECT PEST CONTROL: SAFETY CONSIDERATIONS. MAX D. SUMMERS, RIL0 ENGLER, LOUIS A. FALCON, AND P. VAIL, EDITORS, AMERICAN SOCIETY FOR MICROBIOLOGY, WASHINGTON, DC. PP. 58-62,111-114. (ERL,GB 262).

IN CONCLUSION, I WOULD LIKE TO POINT OUT THE DIFFICULTY OF WORKING WITH SOME OF THESE NONINSECT INVERTEBRATES. IT IS VERY HARD TO WORK WITH SOME OF THE MARINE INVERTEBRATES, FOR WHICH THERE ARE NO CELL LINES; THEY ARE NOT EVEN AMENABLE TO CULTURING OF THE WHOLE ORGANISM. ONE THEREFORE CAN ANTICIPATE RUNNING INTO PROBLEMS, EXTREME PROBLEMS, IN TESTING OR APPLYING TESTS OF THE NPVS AND GVS TO THESE ORGANISMS. THIS IS A PIONEERING FIELD WITH REGARD TO AQUATIC ORGANISMS, BUT I THINK IT HAS GREAT PROMISE. I WOULD EMPHASIZE MY ORIGINAL POINT THAT WE SHOULD START CLOSE TO THE SOURCE FROM A CONCEPTUAL POINT OF VIEW IN TESTING SOME OF THE NPVS AND GVS AND LOOK CRITICALLY AT THE EFFECT ON OTHER ARTHROPODS, PARTICULARLY CRUSTACEA. IN CONCLUSION, THE MAJOR NEW EVIDENCE THAT EMERGES HERE IS THAT MANY GROUPS OF INVERTEBRATES ARE CAPABLE OF HARBORING VIRUSES THAT FORMERLY WERE STUDIED ONLY IN MORE OBVIOUS INSECT HOSTS. THUS, WE MAY NEED TO BROADEN OUR VIEWS ON VIRUS-HOST CONCEPTS AND SEEK MORE WIDELY FOR HOST-VIRUS INTERACTIONS.

COUCH, JOHN A. 1974. ENZOOTIC NUCLEAR POLYHEDROSIS VIRUS OF PINK SHRIMP: ULTRASTRUCTURE, PREVALENCE, AND ENHANCEMENT. J. INVERTEBR. PATHOL. 24(3):311-331. (ERL,GB 215).

A NUCLEAR POLYHEDROSIS VIRUS EXISTS IN PINK SHRIMP, *PENAEUS DUORARUM*, FROM WATERS OF THE NORTHERN GULF OF MEXICO. THIS VIRUS IS ROD-SHAPED, 269 NM LONG, AND POSSESSES AN OUTER ENVELOPE SURROUNDING ITS NUCLEOCAPSID. THE NUCLEOCAPSID IS 50 NM IN DIAMETER. THE VIRUS OCCURS IN NUCLEI OF HOST HEPATOPANCREATIC AND MIDGUT CELLS, AND IS BOTH FREE IN THE NUCLEUS AND OCCLUDED WITHIN PYRAMIDAL-SHAPED POLYHEDRAL INCLUSION BODIES (PIB'S). HISTOCHEMICALLY AND ULTRASTRUCTURALLY, THE SHRIMP PIB'S APPEAR TO BE RIBONUCLEOPROTEIN AND IN FINE STRUCTURE BEAR CLOSE RESEMBLANCE TO POLYHEDRAL INCLUSION BODIES OF BACULOVIRUS SPECIES FROM INSECTS. HOWEVER, THE LATTICE LINE-TO-LINE SPACING IS GREATER THAN THAT USUALLY REPORTED FOR INSECT PIB'S. CROWDING AND CHEMICAL STRESS OF SHRIMP IN AQUARIA MAY ENHANCE AND INCREASE THE VIRUS INFECTION AND PREVALENCE. IN LIMITED EXPERIMENTS, SHRIMP FED HEAVILY INFECTED HEPATOPANCREATIC TISSUES HAD MUCH HIGHER MORTALITY THAN CONTROLS FED ONLY FISH. THE VIRUS APPEARS TO BE ENZOOTIC IN PINK SHRIMP IN NATURE. CYTOPATHOLOGICAL CHANGES IN INFECTED CELLS OF SHRIMP APPEAR SIMILAR TO THOSE IN INSECTS INFECTED WITH CERTAIN SPECIES OF BACULOVIRUS. THE NAME BACULOVIRUS *PENAEI* N.SP. IS PROPOSED FOR THE SHRIMP VIRUS.

COUCH, JOHN A. 1974. FREE AND OCCLUDED VIRUS, SIMILAR TO BACULOVIRUS, IN HEPATOPANCREAS OF PINK SHRIMP. NATURE. 247(5438):229-231. (ERL,GB 213).

A ROD-SHAPED, FREE AND OCCLUDED VIRUS EXISTS IN A MARINE SHRIMP, INDICATING THAT MARINE CRUSTACEA ARE POTENTIAL HOSTS FOR VIRUSES SIMILAR TO CERTAIN VIRUSES INFECTING INSECTS AND MITES. SO FAR, THE VIRUS HAS BEEN FOUND ONLY IN SHRIMP TAKEN FROM NEAR CEDAR KEY AND EXPERIMENTALLY EXPOSED TO THE TOXIC CHEMICAL, AROCLOR 1254 (PCB). THE VIRUS PROBABLY IS A NATURAL PARASITE, HOWEVER, PREVIOUSLY UNDETECTED, OF ESTUARINE AND MARINE SHRIMP. STUDIES OF POSSIBLE INTERACTIONS OF THE PCB AND VIRUS IN PINK SHRIMP MAY PROVIDE VALUABLE INFORMATION NEEDED TO CLARIFY THE RELATIONSHIP BETWEEN NATURAL INFECTIOUS DISEASES AND POLLUTANT CHEMICALS IN THE AQUATIC ENVIRONMENT.

COUCH, JOHN A. 1974. PATHOLOGICAL EFFECTS OF UROSPORIDIUM (HAPLOSPORIDA) INFECTION IN MICROPHALLID METACERCARIAE. J. INVERTEBR. PATHOL. 23(3):389-396. (ERL,GB 211).

EXTENSIVE PATHOLOGICAL CHANGES OCCUR IN MEGALOPHALLUS METACERCARIAE AS A RESULT OF NATURAL INFECTIONS BY THE HAPLOSPROIDAN HYPERPARASITE UROSPORIDIUM CRESCENS. INFECTED AND UNINFECTED METACERIAE, RECOVERED FROM BLUE CRABS FROM CHINCOTEAGUE BAY, MARYLAND, WERE EXAMINED AND COMPARED HISTOLOGICALLY IN REGARD TO CONDITION OF METACERCARIAL CYST WALL, TEGUMENT, AND SPECIALIZED PARENCHYMAL CELLS. CHANGES FROM NORMAL FOUND IN HEAVILY INFECTED METACERCARIAE WERE (1) SUPPRESSION AND REPLACEMENT OF POSSIBLE SECRETORY AND PARENCHYMAL CELLS BY THE HYPERPARASITE, (2) LACK OF RETICULIN STROMATA, POLYSACCHARIDES, AND ACID MUCOPOLYSACCHARIDES, (3) REDUCTION IN THICKNESS OF CYST WALL, TEGUMENTAL, AND CONNECTIVE TISSUE STRUCTURES, AND (4) LOSS OF MOBILITY AND RESISTANCE TO MECHANICAL PRESSURES. THOUGH SEVERE PATHOLOGICAL CHANGES OCCUR IN HEAVILY INFECTED METACERCARIAE, MOST INFECTED METACERCARIAE REMAIN VIABLE WITHIN THE BLUE CRAB AND THEREBY SERVE AS A VECTOR FOR UROSPORIDIUM UNTIL THE DEATH OF THE BLUE CRAB. AT THE TIME OF THE CRAB'S DEATH AND DISORGANIZATION, INFECTED METACERCARIAE RUPTURE AND RELEASE SPORES OF THE HYPERPARASITE.

COUCH, JOHN A. 1975. VIRUS FROM PINK SHRIMP (ABSTRACT). PRESENTED AT THE FIRST WORKSHOP ON THE PATHOLOGY AND TOXICOLOGY OF PENAEID SHRIMP, APRIL 8-10, 1975, GALVESTON, TX. (ERL,GB X291).

SINCE THE REPORT OF A BACULOVIRUS FOUND IN PINK SHRIMP APPEARED OVER ONE YEAR AGO, CONSIDERABLE INFORMATION HAS ACCUMULATED ON THE VIRUS-SHRIMP RELATIONSHIP. THE FOLLOWING TENETS APPEAR TO HOLD: (1) A BACULOVIRUS (NUCLEAR POLYHEDROSIS VIRUS) INFECTS PINK SHRIMP NATURALLY YEAR ROUND IN CERTAIN AREAS OF THE GULF OF MEXICO; (2) THE VIRUS CAUSES CONSIDERABLE CYTOPATHOLOGY IN HEAVY INFECTIONS OF THE HEPATOPANCREAS; (3) THE VIRUS IS ENZOOTIC AND MAY BECOME EPIZOOTIC UNDER CERTAIN STRESS CONDITION TO WHICH THE HOST IS EXPOSED; AND (4) SHRIMP ARE SIMILAR TO OTHER ARTHROPODS IN BEING HOSTS FOR AT LEAST ONE VIRUS.

COUCH, JOHN A. 1976. ATTEMPTS TO INCREASE BACULOVIRUS PREVALENCE IN SHRIMP BY CHEMICAL EXPOSURE. IN: TUMORS IN AQUATIC ANIMALS. CLYDE J. DAWE, DANTE G. SCARPELLI, AND SEFTON R. WELLINGS, EDITORS, S. KARGER, BASEL. 20:304-314. (ERL,GB 240).

LITTLE INFORMATION IS AVAILABLE CONCERNING INTERACTIONS BETWEEN POLLUTANT CHEMICALS AND VIRUSES IN AQUATIC ANIMALS. SAMPLES OF PINK SHRIMP (PENAEUS DUORARUM) WITH VARIOUS ENZOOTIC LEVELS OF A NATURAL BACULOVIRUS INFECTION WERE EXPERIMENTALLY EXPOSED TO LOW LEVELS OF AROCLOR 1254, A POLYCHLORINATED BIPHENYL (PCB), MIREX, CADMIUM, AND METHOXYCHLOR IN THE LABORATORY. NO CONSISTENT PATTERN OF INCREASE IN PREVALENCE OF VIRUS WAS FOUND, AND NO INDICATION OF TUMOR INDUCTION WAS DETECTED.

COUCH, JOHN A. 1977. INTERACTION OF THREE PATHOGENS IN MASS MORTALITY OF PENAEID SHRIMP (ABSTRACT). (ERL,GB X295).

A BACULOVIRUS, A CILIATE OF THE GENUS PARAURONEMA, AND A FLAGELLATE TENTATIVELY IDENTIFIED AS A SPECIES OF LEPTOMONAS HAVE BEEN FOUND IN CULTURED BROWN SHRIMP LARVAE SUFFERING MASS MORTALITIES IN NORTHWEST FLORIDA. A SPECIES OF THE SUCTORIAN GENUS EPHELOTA HAS ALSO BEEN FOUND IN LOW DENSITY ATTACHED TO THE CUTICLE OF SOME OF THESE LARVAE, ALONG WITH TROPHONTS OF A PETITRICH, ZOOTHAMNIUM SP. THE BACULOVIRUS IS THE SAME AS DESCRIBED PREVIOUSLY FROM ADULT AND JUVENILE PENAEID SHRIMPS. THE VIRUS INFECTS NUCLEI OF HEPATOPANCREATIC CELLS IN 20% OF LARVAE EXAMINED AND DESTROYS UP TO 80% OF THESE CELLS IN SOME LARVAE. CHARACTERISTIC POLYHEDRAL INCLUSION BODIES ARE PASSED IN THE SLOUGHED CELLULAR DEBRIS AND ELIMINATED IN THE FECES. PROTOZOA 1 LARVAE APPARENTLY BECOME INFECTED BY FEEDING ON FECES OR POSSIBLY THROUGH TRANSOVARIAN TRANSMISSION FROM FEMALE SHRIMP TO OFFSPRING. CANNIBALISM IS ANOTHER SOURCE OF DIRECT INFECTION. THE CILIATE PARAURONEMA INVADED THE HEMOCOELE AND APPENDAGES OF 29% OF THE LARVAL SHRIMP EXAMINED DISPLACING AND MECHANICALLY ALTERING TISSUES. THIS CILIATE MAY INVADE THROUGH BREAKS IN THE CUTICLE OF MOLTING LARVAE OR THROUGH THE MID GUT REGION WHERE HEPATOPANCREATIC CELLS ARE SLOUGHED FOLLOWING VIRAL LYSIS, OR FLAGELLATE INFECTIONS.

COUCH, JOHN A. 1978. DISEASES, PARASITES, AND TOXIC RESPONSES OF COMMERCIAL PENAEID SHRIMPS OF THE GULF OF MEXICO AND SOUTH ATLANTIC COASTS OF NORTH AMERICA. U.S. FISH WILDL. SERV. FISH. BULL. 76(1):1-44. (ERL,GB 283).

A REFERENCE WORK AND REVIEW OF BOTH INFECTIOUS AND NONINFECTIOUS DISEASES OF COMMERCIAL PENAEID SHRIMPS OF THE GULF AND SOUTH ATLANTIC REGION OF THE UNITED STATES IS PRESENTED. DISEASE IS SECOND ONLY TO PREDATION AND PERIODIC PHYSICAL CATASTROPHES IN LIMITING NUMBERS OF PENAEID SHRIMPS IN NATURE AND SECOND ONLY TO NUTRITIONAL AND REPRODUCTIVE REQUIREMENTS IN LIMITING AQUACULTURAL SUCCESSES WITH PENAEID SHRIMPS. INFECTIOUS AGENTS CAUSING DISEASE IN PENAEID SHRIMPS ARE A VIRUS, BACTERIA, FUNGI, PROTOZOA, HELMINTHES, AND NEMATODES. A WELL-DESCRIBED BACULOVIRUS INFECTS LARVAL AND ADULT SHRIMP AND IS ASSOCIATED WITH MORTALITY, PARTICULARLY IN LARVAL SHRIMP. BACTERIA OF THE GENERA VIBRIO, SENECKEA, AND LEUCOTHRIX ARE ASSOCIATED WITH DISEASE IN PENAEID SHRIMPS, BUT BACTERIAL ROLES IN MORTALITY ARE UNCLEAR. THE SAME IS LARGELY TRUE FOR FUNGI WITH MEMBERS OF THE GENERA LAGENIDIUM AND FUSARIUM CAUSING PATHOGENESIS IN CULTURED SHRIMP. LAGENIDIUM CAUSES SEVERE DESTRUCTION OF LARVAL SHRIMP TISSUES. OF THE MANY PROTOZOAN GROUPS REPRESENTED IN AND ON PENAEID SHRIMPS AS TISSUE PARASITES AND COMMENSALS, THE MICROSPORIDA OF THE GENERA NOSEMA, THELOHANIA, AND PLEISTOPHORA ARE THE MOST DESTRUCTIVE. THE CILIATE PROTOZOA ZOOTHAMNIUM SP., LAGENOPHRYS SP., AND PARAUONEMA SP. MAY CAUSE DYSFUNCTION IN SHRIMP. AN UNDESCRIBED APOSTOME CILIATE IS ASSOCIATED WITH BLACK GILL DISEASE. A SUCTORIA, EPHELOTA SP., IS AN ECTOCOMMENSAL OF LARVAL SHRIMP, ATTACHING TO THE CUTICLE. THE SIX SPECIES OF GREGARINES REPORTED CAUSE LITTLE OR NO PATHOGENESIS, AND A SINGLE REPORTED FLAGELLATE SPECIES ROLE IN SHRIMP HEALTH IS UNCERTAIN. FLATWORMS FOUND IN PENAEID SHRIMPS ARE METECARCARIAE OF A SPECIES OF MICROPHALLUS IN MUSCLES AND VISCERA, METACERCARIAE OF OPECDELOIDES FIMBRIATUS IN VISCERA, PLEROCERCROID LARVAE OF PROCHRISTIANELLA HISPIDA IN THE HEPATOPANCREAS AND HEMOCOEL, AND FOUR OTHER CESTODE DEVELOPMENTAL STAGES. NEMATODES FOUND ARE THYNNASCARES SP., SPIROCAMALLANUS PEREIRAI, LEPTOLAIMUS SP., AND CROCONEMA SP. NONINFECTIOUS DISEASE AGENTS IN PENAEID SHRIMPS ARE CHEMICAL POLLUTANTS, HEAVY METALS, AND ENVIRONMENTAL STRESSES. ORGANOCHLORINE, ORGANOPHOSPHATE, AND CARBAMATE PESTICIDES ALL HAVE ADVERSE EFFECTS IN PENAEIDS. FRACTIONS OF PETROLEUM, PARTICULARLY THE NAPHTHALENES, ARE VERY TOXIC TO SHRIMP. LITTLE OTHER WORK HAS BEEN DONE ON THE EFFECTS OF PETROLEUM ON PENAEID SHRIMPS. CADMIUM CAUSES BLACK GILLS IN SHRIMP BY KILLING GILL CELLS. MERCURY IS ACCUMULATED BY PENAEIDS AND MAY INTERFERE WITH THEIR OSMOREGULATORY ABILITIES. MANY CHEMOTHERAPEUTIC CHEMICALS USED ROUTINELY IN TREATMENT OF FISH DISEASES ARE TOXIC TO SHRIMP AT CERTAIN DETERMINED CONCENTRATIONS. SPONTANEOUS PATHOSES FOUND ARE A BENIGN TUMOR, MUSCLE NECROSIS, AND GAS BUBBLE DISEASE. "SHELL DISEASE" IS DISCUSSED FROM POINTS OF VIEW OF POSSIBLE CAUSES. A SYNDROME OF "BROKEN BACKS" IS REPORTED IN PENAEID SHRIMPS FOR THE FIRST TIME. AN OVERVIEW IS PRESENTED FOR GENERAL NEEDS IN PENAEID SHRIMP HEALTH RESEARCH.

COUCH, JOHN A. 1979. SHRIMPS (ARTHROPODA: CRUSTACEA: PENAEIDAE). IN: POLLUTION ECOLOGY OF ESTUARINE INVERTEBRATES. C.W. HART, JR. AND L.H. SAMUEL, EDITORS, ACADEMIC PRESS, NEW YORK, NY. PP. 235-258. (ERL,GB X046).

THE MAJORITY OF REPORTS AVAILABLE ABOUT POLLUTION AND PENAEID SHRIMPS CONCERNS STUDIES INVOLVING THE COMMERCIALY VALUABLE PENAEID SHRIMPS OF THE U.S. ATLANTIC STATES AND GULF COAST. THEREFORE, MOST OF THE INFORMATION PRESENTED HERE WILL BE RELATED TO THE FOLLOWING THREE SPECIES: PENAEUS DUORARUM (PINK SHRIMP), PENAEUS AZTECUS (BROWN SHRIMP), AND PENAEUS SETIFERUS (WHITE SHRIMP), ALL ATLANTIC AND GULF OF MEXICO SPECIES. REFERENCE TO OTHER SPECIES OF PENAEID AND SOME NONPENAEID CRUSTACEA WILL BE MADE WHEN SPECIFIC STUDIES CONTRIBUTE SIGNIFICANTLY TO OUR UNDERSTANDING OF POLLUTION ECOLOGY OF SHRIMPS. THIS CHAPTER WILL COVER THE FOLLOWING POLLUTANT CATEGORIES AND SITUATIONS: ORGANIC CHEMICALS OTHER THAN PETROLEUM, PETROLEUM AND RELATED COMPOUNDS, HEAVY METALS, BIOLOGICAL AGENTS, AND INTERACTIONS OF POLLUTANTS AND OTHER FACTORS. UNDER EACH OF THESE DIVISIONS TOXICITY AND SPECIFIC TISSUE, ORGANISMIC, POPULATION, AND ECOLOGICAL EFFECTS WILL BE REVIEWED WHEN KNOWN. FURTHER, THE UPTAKE, TRANSPORT, AND FATE OF POLLUTANTS WILL BE DISCUSSED AS THEY MAY AFFECT THE ECOLOGY OF PENAEID SHRIMPS

COUCH, JOHN A. 1981. VIRAL DISEASES OF INVERTEBRATES OTHER THAN INSECTS. IN: PATHOGENESIS OF INVERTEBRATE MICROBIAL DISEASES. ELIZABETH W. DAVIDSON, EDITOR, ALLENHELD, OSMUN, TOTOWA, NJ. PP. 127-160. (ERL,GB 274).

THIRTEEN EXAMPLES OF VIRUS OR VIRUSLIKE RELATED PATHOSES IN NON-INSECT INVERTEBRATES ARE DESCRIBED. FROM CONSIDERATION OF THESE EXAMPLES, IT BECOMES OBVIOUS THAT DETAILED DESCRIPTIONS OF PATHOGENESIS OF VIRUS DISEASES IN NON-INSECT INVERTEBRATES HAS NOT KEPT PACE WITH THE FREQUENCY OF NEW REPORTS OF VIRUSES FROM THESE INVERTEBRATES. WHEN POSSIBLE, IT IS OF UPMOST IMPORTANCE FOR AUTHORS REPORTING VIRAL ENTITIES FROM INVERTEBRATES TO INCLUDE AS MUCH INFORMATION AS CAN BE COLLECTED ON THE DISEASE SYNDROME, CELLULAR PATHOGENESIS, PHYSIOLOGICAL AND BEHAVIORAL EFFECTS AND TISSUE DISTRIBUTION OF THE VIRUS. IN SOME CASES, INFORMATION HAS BEEN SO SCANT THAT READERS ARE NOT EVEN CERTAIN AS TO THE PREVALENCE OF THE VIRUS IN REPORTED HOSTS. BASIC INFORMATION ON THE NATURE OF NON-INSECT INVERTEBRATE VIRUS DISEASES IS NEEDED FOR SEVERAL REASONS. INSIGHTS INTO MECHANISMS OF PATHOGENESIS AND PATHOGENIC EFFECTS IN INVERTEBRATE VIRUSES MAY GIVE BETTER UNDERSTANDING OF VERTEBRATE VIRUS DISEASES. FURTHER, A MAJOR OPPORTUNITY EXISTS WITH INVERTEBRATE VIRUS DISEASE TO INVESTIGATE THE FUNDAMENTAL ASPECTS OF CELLULAR IMMUNITY.

COUCH, JOHN A. 1983. DISEASES CAUSED BY PROTOZOA. IN: BIOLOGY OF CRUSTACEA: ECONOMIC ASPECTS: FISHERIES, CULTURE AND PATHOBIOLOGY, VOL. 6. ANTHONY J. PROVENZANO, EDITOR, ACADEMIC PRESS, NEW YORK, NY. PP. 79-111. (ERL,GB 380).

CRUSTACEA SERVE AS HOSTS TO SYMBIOTIC, COMMENSAL, PARASITIC, AND PATHOGENIC REPRESENTATIVES OF ALL MAJOR TAXA OF PROTOZOA. STUDIES OF MICROSPORIDIAN EPIZOOTICS IN SHRIMP (VIGSCA, 1943; INVERSEN AND MANNING, 1959), CRAYFISH (PIXELL-GOODRICH, 1956), AND OTHER DECAPOD CRUSTACEA (PIXELL-GOODRICH, 1928; SPRAGUE, 1970A), AMOEBIC EPIZOOTICS IN CRABS (SPRAGUE ET AL., 1969; J.A. COUCH, UNPUBLISHED; NEWMAN AND WARD, 1973; JOHNSON, 1977), AND CILIATE PROTOZOAN OUTBREAKS IN SHRIMPS AND CRABS (COUCH, 1967A, 1978; OVERSTREET, 1973; LIGHTNER, 1975) DEMONSTRATE THE STRONG PERIODIC AND CHRONIC IMPACT OF PROTOZOA.

COUCH, JOHN A., AND LEE COURTNEY. 1977. INTERACTION OF CHEMICAL POLLUTANTS AND VIRUS IN A CRUSTACEAN: A NOVEL BIOASSAY SYSTEM. ANN. N.Y. ACAD. SCI. 298:497-504. (ERL,GB 300).

A LARGE GROUP OF SHRIMP, 23.3% OF WHICH HAD LIGHT PATENT BACULOVIRUS INFECTIONS, WAS DIVIDED EQUALLY INTO TWO GROUPS. ONE GROUP WAS EXPOSED TO THE CHEMICAL STRESSOR AROCLOR 1254 (A POLYCHLORINATED BIPHENYL) AT 0.7 PPB FOR 35 DAYS IN FLOWING SEAWATER. THE OTHER GROUP WAS MAINTAINED AS A CONTROL GROUP IN FLOWING SEAWATER. VIRAL PREVALENCE IN EXPOSED SHRIMP SAMPLES INCREASED WITH TIME AT A SIGNIFICANTLY GREATER RATE THAN DID VIRAL FREQUENCY IN CONTROL SHRIMP. VIRAL PREVALENCE IN AROCLOR-EXPOSED SHRIMP SURVIVORS WAS 75% AFTER 35 DAYS, WHEREAS IN CONTROL SHRIMP, ONLY 45.7% HAD PATENT VIRAL INFECTIONS. THIS FINDING SUGGESTS AN INTERACTION AMONG CHEMICAL STRESSOR (AROCOR 1254), HOST, AND VIRUS. THE NATURE OR MECHANISM OF THIS INTERACTION HAS NOT BEEN DEFINED, BUT THE SHRIMP-VIRUS SYSTEM SHOWS PROMISE FOR FUTURE BIOASSAYS OF INFLUENCE OF LOW CONCENTRATIONS OF POLLUTANTS ON NATURAL PATHOGEN-HOST INTERACTIONS.

COUCH, JOHN A., AND SUSAN MARTIN. 1982. PROTOZOAN SYMBIONTS AND RELATED DISEASES OF THE BLUE CRAB, CALLINECTES SAPIDUS RATHBUN, FROM THE ATLANTIC AND GULF COASTS OF THE UNITED STATES. IN: PROCEEDINGS OF THE BLUE CRAB COLLOQUIUM, BILOXI, MISSISSIPPI, OCTOBER 16-19, 1979. HARRIET M. PERRY AND W. A. VAN ENGEL, EDITORS, GULF STATES MARINE FISHERIES COMMISSION, OCEAN SPRINGS, MS. PP. 71-80. (ERL,GB 325).

THE BLUE CRAB (CALLINECTES SAPIDUS RATHBUN, 1896) SUPPORTS VALUABLE FISHERIES ALONG THE MID-ATLANTIC AND GULF COASTS OF THE UNITED STATES. BECAUSE THE CRAB IS AN ESTUARINE SPECIES, CAPABLE OF RANGING WIDELY WITHIN ITS HABITAT, IT IS SUBJECT TO THE RIGORS OF THE EURYHALINE ENVIRONMENT, AS WELL AS TO THE STRESSES CAUSED BY HUMAN ACTIVITY ALONG COASTLINES. IT HAS BEEN DEMONSTRATED THAT CAPTIVE-CRAB POPULATIONS ARE PARTICULARLY SUSCEPTIBLE TO PARASITES AND COMMENSALS, AND TO THEIR ASSOCIATED DISEASE AND DEBILITIES. WITHIN WILD POPULATIONS, EXTENSIVE MORTALITIES DUE TO THESE FACTORS ARE DIFFICULT TO MONITOR, BUT DO CAUSE FLUCTUATING LOSSES TO THE CRAB FISHERY. THIS PAPER REVIEWS EXISTING KNOWLEDGE ON THE MORE COMMON PROTOZOAN SYMBIONTS AND DISEASES OF THE BLUE CRAB FOUND ON THE EASTERN AND GULF COASTS. AVAILABLE INFORMATION ON RECOGNITION AND DIAGNOSIS OF DISEASE, SITE OF INFECTION, AND PATHOGENICITY IS INCLUDED. DATA ARE PRESENTED ON TAXONOMY, MORPHOLOGY, AND LIFE CYCLES OF ASSOCIATED PROTOZOAN PARASITES AND COMMENSALS OF CALLINECTES SAPIDUS.

COUCH, JOHN A., AND D.R. NIMMO. 1974. DETECTION OF INTERACTIONS BETWEEN NATURAL PATHOGENS AND POLLUTANTS IN AQUATIC ANIMALS. IN: PROCEEDINGS OF THE REGIONAL SYMPOSIUM ON DISEASES OF AQUATIC ANIMALS. LSU-SG-74-05, LOUISIANA STATE UNIVERSITY, CENTER FOR WETLAND RESOURCES, BATON ROUGE, LA. PP. 261-268. (ERL,GB 219).

THE PURPOSE OF THIS PAPER IS TO GIVE TWO EXAMPLES OF THE DETECTION OF POSSIBLE INTERACTIONS BETWEEN NATURAL PATHOGENS AND CHEMICAL POLLUTANTS IN SELECTED GULF OF MEXICO, ESTUARINE ANIMALS. THESE WILL INCLUDE RESULTS OF BOTH EXPERIMENTAL LABORATORY WORK AND FIELD OBSERVATIONS IN THE VICINITY OF PENSACOLS, FLORIDA.

COUCH, JOHN A., AND DELWAYNE R. NIMMO. 1973. CYTOPATHOLOGY, ULTRASTRUCTURE, AND VIRUS INFECTION IN PINK SHRIMP EXPOSED TO THE PCB, AROCLOR 1254 (ABSTRACT). IN: PROCEEDINGS OF THE JOINT MEETING OF THE SOCIETY FOR INVERTEBRATE PATHOLOGY AND INTERNATIONAL COLLOQUIUM ON INSECT PATHOLOGY AND MICROBIAL CONTROL. PP. 105. (ERL,GB 242).

LITTLE INFORMATION IS AVAILABLE CONCERNING THE EFFECTS OF POLLUTANT CHEMICALS ON THE FINE STRUCTURE OF TISSUES IN AQUATIC INVERTEBRATES. EVEN LESS IS KNOWN CONCERNING POSSIBLE INTERACTIONS OF POLLUTANT CHEMICALS AND NATURAL PATHOGENS IN VALUABLE INVERTEBRATE SPECIES. IN EXPERIMENTS AT THE GULF BREEZE, FLORIDA EPA LABORATORY WE HAVE EXPOSED PINK SHRIMP (PENAEUS DUORARUM) TO 3 PPB AROCLOR 1254 IN FLOWING SEAWATER FROM 30 TO 52 DAYS. DURING THESE EXPOSURES UP TO 50% OR MORE OF THE ANIMALS DIED. SAMPLES OF BOTH LIVING AND DEAD SHRIMP WERE ANALYZED FOR AROCLOR RESIDUES AND, AFTER 30 DAYS EXPOSURE, WERE FOUND TO ACCUMULATE FROM 33 PPM TO 40 PPM IN THEIR HEPATOPANCREATIC TISSUES.

COUCH, JOHN A., AND K. RANGA RAO, EDITORS. 1983. BIORATIONAL WORKSHOP, GULF BREEZE, FLORIDA, SEPTEMBER 15-17, 1982. EPA-600/X-83-054, U.S. ENVIRONMENTAL PROTECTION AGENCY, ENVIRONMENTAL RESEARCH LABORATORY, GULF BREEZE, FL. 64P.

THE GENERAL PURPOSE OF THE WORKSHOP WAS TO EVALUATE THE STATE-OF-THE-ART OF TESTING, AND THE SAFETY OF BIORATIONALS TO BIRDS, MAMMALS, AQUATIC ORGANISMS, PLANTS, AND INSECTS AND TO REVIEW THE PART OF SUBPART H OF THE GUIDELINES (GUIDELINES DOCUMENT FOR REGISTERING PESTICIDES IN THE U.S.: BIORATIONALS) DRAFTED BY THE ECOLOGICAL EFFECTS BRANCH, OFFICE OF PESTICIDES PROGRAMS (HED/OPP).

COUCH, JOHN A., MAX D. SUMMERS, AND LEE COURTNEY. 1975. ENVIRONMENTAL SIGNIFICANCE OF BACULOVIRUS INFECTIONS IN ESTUARINE AND MARINE SHRIMP. ANN.N.Y. ACAD. SCI. 266:528-536. (ERL,GB 253).

CERTAIN ENVELOPED, ROD-SHAPED DNA VIRUSES HAVE LONG BEEN KNOWN AS PATHOGENS OF INSECTS UNDER THE DESCRIPTIVE TERM "NUCLEAR POLYHEDROSIS VIRUSES." THESE VIRUSES HAVE BEEN EXTENSIVELY AND INTENSIVELY STUDIED SINCE BERGHOLD'S EARLY REPORTS IN 1947. SUBSEQUENT TO BERGHOLD'S CLASSIC EARLY STUDIES, MANY ROD-SHAPED VIRUSES ASSOCIATED WITH POLYHEDRAL INCLUSION BODIES OF A CRYSTALLINE NATURE HAVE BEEN DESCRIBED FROM DIFFERENT SPECIES OF INSECTS THAT REPRESENT SEVERAL ORDERS OF INSECTA. AT PRESENT, THE INTERNATIONAL COMMITTEE ON NOMENCLATURE OF VIRUSES PLACES THE NUCLEAR POLYHEDROSIS VIRUSES OF ARTHROPODS IN SUBGROUP A UNDER THE GENUS OR GROUP NAME BACULOVIRUS. PRIOR TO 1973, THERE WERE NO REPORTS OF VIRUSES THAT RESEMBLE BACULOVIRUSES IN ANIMALS OTHER THAN INSECTS OR MITES. IN 1973 AND 1974, THE FIRST REPORTS WERE MADE OF BACULOVIRUS-LIKE PARTICLES AND ASSOCIATED POLYHEDRAL INCLUSION BODIES IN A NONINSECT ARTHROPOD HOST. THE NEW HOST WAS THE PINK SHRIMP, PENAEUS DUORARUM, FROM FLORIDA WATERS OF THE NORTHERN GULF OF MEXICO. THESE REPORTS INDICATED FOR THE BACULOVIRUS GROUP A HOST RANGE EXTENSION INTO THE ARTHROPOD CLASS CRUSTACEA. IN REGARD TO SPECIFIC CHARACTERIZATION AND IDENTIFICATION OF THE SHRIMP VIRUS, IT IS PERTINENT TO REPORT THAT NOT ALL OF KOCH'S POSTULATES HAVE BEEN SATISFIED. KOCH'S POSTULATES, HOWEVER, WERE MEANT TO BE USED TO SHOW SPECIFICITY OF A MICROORGANISM AS AN ETIOLOGIC AGENT FOR A DISEASE CONDITION AND NOT SPECIFICALLY TO DETERMINE PHYLOGENETIC AFFINITY OR IDENTITY OF THE MICROORGANISM. THE LATTER TASK (IDENTIFICATION) INCLUDES DETERMINATION OF BIOLOGIC, MORPHOLOGIC, CHEMICAL AND PHYSICAL CHARACTERISTICS. MUCH OF OUR EFFORT HAS GONE INTO THESE DETERMINATIONS FOR THE SHRIMP VIRUS. THE FIRST OF KOCH'S POSTULATES (THAT OF ASSOCIATION OR PRESENCE OF A MICROORGANISM WITH A DISEASE CONDITION) HAS BEEN SATISFIED FOR PATENT VIRUS INFECTIONS IN SHRIMP; THAT IS, INCLUSION BODIES AND VIRION ARE PRESENT IN ALL PATENT INFECTIONS THAT EXHIBIT CYTOPATHOLOGIC CHARACTERISTICS. THE SECOND OF KOCH'S POSTULATES (THAT OF ISOLATION AND PURE CULTURE OF THE MICROORGANISM) HAS NOT BEEN SATISFIED FOR THE SHRIMP VIRUS AND POSES A SEVERE PROBLEM BECAUSE OF THE LACK OF CONTINUOUS CELL CULTURES OF CRUSTACEAN TISSUES IN WHICH TO ISOLATE AND GROW THE VIRUS. AT PRESENT, WE ARE ATTEMPTING TO USE ESTABLISHED INSECT CELL LINES IN WHICH TO GROW THE SHRIMP VIRUS. THE BACULOVIRUSES HAVE ATTRACTED MUCH ATTENTION IN RECENT YEARS LARGELY BECAUSE SOME MICROBIOLOGISTS AND ENTOMOLOGISTS CONSIDER THESE VIRUSES TO BE PROMISING BIOLOGIC CONTROL AGENTS FOR NUMEROUS INSECT PESTS. THE INSECT BACULOVIRUSES HAVE SHOWN NARROW HOST SPECIFICITY, AND ALL EXPERIMENTAL ATTEMPTS SO FAR TO INFECT NONINSECT SPECIES WITH INSECT BACULOVIRUSES HAVE FAILED. THE PURPOSE OF THE PRESENT PAPER IS TO CONSIDER THE SIGNIFICANCE OF THE SHRIMP VIRUS IN REGARD TO THE ECOLOGY OF ITS CRUSTACEAN HOST.

COUCH, JOHN, GEORGE GARONER, JOHN C. HARSHBARGER, M.R. TRIPP, AND PAUL P. YEVICH. 1974. HISTOLOGICAL AND PHYSIOLOGICAL EVALUATIONS IN SOME MARINE FAUNA. IN: MARINE BIJASSAYS. MARINE TECHNOLOGY SOCIETY, WASHINGTON, DC. PP. 156-173. (ERL,GB 250).

THE DEVELOPMENT OF PATHOLOGY, AS APPLIED TO AQUATIC TOXICOLOGY, DEPENDS HEAVILY ON THE KNOWLEDGE OF NORMAL HISTOLOGY AND PHYSIOLOGY IF ANOMALIES, DUE TO POLLUTANTS OR DISEASE, ARE TO BE ACCURATELY DEFINED. HOWEVER, AT PRESENT, KNOWLEDGE OF NORMAL MORPHOLOGY OR METABOLIC ACTIVITIES IS EITHER INCOMPLETE OR LACKING FOR MOST MARINE OR COASTAL ORGANISMS. OBVIOUSLY, WELL-COORDINATED EFFORTS WILL BE REQUIRED TO CHARACTERIZE NORMAL RANGES AND INTERPRET THE MORPHOLOGICAL OR PHYSIOLOGICAL RESPONSES OF AQUATIC ORGANISMS TO VARIOUS FACTORS INCLUDING POLLUTANTS. MOST LABORATORIES CANNOT JUSTIFY WELL-DEFINED PATHOLOGICAL UNITS, ALTHOUGH THE NEED OFTEN ARISES THROUGH GOVERNMENTAL ENFORCEMENT ORGANIZATIONS AND OTHER ACTIVITIES. THE TECHNIQUES AND EXAMPLES THUS PRESENTED ARE INTENDED TO OFFER SOME MEANS OF OBTAINING EVALUATIONS OF AQUATIC ORGANISMS' WELL-BEING OR DISORDERS.

SPRAGUE, VICTOR, AND JOHN COUCH. 1971. ANNOTATED LIST OF PROTOZOAN PARASITES, HYPERPARASITES, AND COMMENSALS OF DECAPOD CRUSTACEA. J. PROTOZOOL. 18(3):526-537. (ERL,GB 133).

AN APPROXIMATELY COMPLETE LIST OF THE KNOWN PROTOZOAN ASSOCIATES (EXCLUSIVE OF A FEW ABERRENT FORMS LIKE AMALLOCYSTIS) OF DECAPODS IS PRESENTED. A FEW TAXONOMIC CHANGES ARE SUGGESTED. HOST, SITE OF INFECTION AND GEOGRAPHIC LOCATION ARE MENTIONED. SOME COMMENTS OF PATHOGENICITY ARE MADE.

SUMMERS, MAX D. 1977. CHARACTERIZATION OF SHRIMP BACULOVIRUS. EPA-600/3-77-130, U.S. ENVIRONMENTAL PROTECTION AGENCY, ENVIRONMENTAL RESEARCH LABORATORY, GULF BREEZE, FL. 36P.

THE RESEARCH UNDERTAKEN INVOLVED THE PARTIAL CHARACTERIZATION OF A BACULOVIRUS OF THE PINK SHRIMP, PENAEUS DUORARUM. THE SIGNIFICANCE OF THE STUDY IS RELATED TO THE FACT THAT THE SHRIMP BACULOVIRUS IS MORPHOLOGICALLY SIMILAR TO INSECT VACULOVIRUSES WHICH WERE CONSIDERED UNIQUE TO INSECT ARTHROPODS PRIOR TO THE DISCOVERY OF SHRIMP NUCLEAR POLYHEDROSIS BACULOVIRUS (NPV). FURTHER, INSECT BACULOVIRUSES ARE BEING DEVELOPED AND APPLIED AS MICROBIAL PESTICIDES FOR THE CONTROL OF CERTAIN AGRICULTURAL INSECT PESTS. WHEREAS THE BACULOVIRUS DISEASES IN PESTS OF AGRICULTURAL OR MEDICAL IMPORTANCE ARE CONSIDERED A DESIRABLE RELATIONSHIP, A BACULOVIRUS INFECTION IN SHRIMP IS AN UNDESIRABLE ONE. RESEARCH INCLUDED INVESTIGATIONS OF THE BIOCHEMICAL, STRUCTURAL, AND, WHERE APPROPRIATE, BIOLOGICAL PROPERTIES OF THE SHRIMP VIRUS AS COMPARED TO THOSE OF KNOWN AND CHARACTERIZED PROPERTIES OF INSECT BACULOVIRUSES, BOTH GRANULOSIS AND NPVS. EVIDENCE FOR ANY STRUCTURAL RELATEDNESS OF THE SHRIMP NPV TO INSECT NPVS HAS BEEN CONFIRMED IN CROSS-REACTIONS OF PURIFIED SHRIMP NPV POLYHEDRIN AND INFECTED SHRIMP TISSUES TO INSECT BACULOVIRUS ANTISERA. THIS REPORT COVERS THE PERIOD SEPTEMBER 23, 1974 TO DECEMBER 31, 1976.