

Issue 65

September 2002



The Poultry Informed Professional

Published by the Department
of Avian Medicine, University of Georgia
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of Avian Medicine

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UNDERSTANDING ANTIBIOTIC RESISTANCE: TODAY

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Karen is a veterinarian working on her PhD in medical microbiology at the University of Georgia. Her research with her professor Dr. John Maurer involves the transfer of antibiotic resistance from poultry to humans by Salmonella.

Broiler Performance Data (Region) Live Production Cost					
	SW	Midwest	Southeast	Mid-Atlantic	S-Central
Feed cost/ton w/o color (\$)	136.70	128.95	141.02	141.87	141.09
Feed cost/lb meat (¢)	12.79	11.86	13.02	13.94	13.04
Days to 4.6 lbs	46	44	44	45	44
Chick cost/lb (¢)	4.07	3.80	3.99	3.55	3.78
Vac-Med cost/lb (¢)	0.05	0.03	0.06	0.04	0.03
WB & 1/2 parts condemn. cost/lb	0.20	0.19	0.13	0.16	0.18
% mortality	4.97	4.07	3.97	4.72	3.70
Sq. Ft. @ placement	0.80	0.79	0.82	0.81	0.82
Lbs./Sq. Ft.	6.11	6.65	6.37	6.81	6.46
Down time (days)	11	10	11	13	13

Data for week ending 08/24/02

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Ten years ago Dr. Stuart Levy, in an article in Scientific American, described the problem of antibiotic resistance in bacteria and the mechanisms by which this resistance is acquired. Today we know a lot more about the molecular mechanisms by which bacteria transfer genes, and about how these genes are maintained in populations. As our molecular biology tools have improved, we have gained insight into the complex ecology of bacterial populations, and have discovered an amazing array of mobile genetic elements. We have found that these mobile genetic elements play a central role in the spread and maintenance of antibiotic resistance genes. It has also been discovered that the exchange of genetic material occurs between unrelated or distantly related bacteria. Some of the more current issues in antibiotic resistance research include; the emergence of multiple drug resistance, the linkage of antibiotic resistance genes, the real-time evolution of beta-lactamases, the evolution of complex transposon structures, and the persistence of resistance without selection pressure. The information we have collected points to a much more complex situation regarding the development of antibiotic resistance than previously thought possible. We now need to think in a broader way of the antibiotic resistance ecosystem, in which antimicrobial resistance in many different types of bacteria from many different environments is being selected for by pressures generated by the variety of ways antibiotics are used in our society and dispersed into the environment.

Mechanisms of Antibiotic Resistance

The basic molecular mechanisms of antibiotic resistance are: 1) Alter or destroy the antibiotic, 2) Modify the target of the antibiotic, 3) Exclude the antibiotic from the cell, 4) Pump the antibiotic back out of the cell, or 5) By-pass the metabolic pathway that is the target of the antibiotic (figure 1).

Resistance to the penicillins and cephalosporins is accomplished by the first mechanism. The enzyme betalactamase is secreted into the periplasmic space or environment, and cleaves the lactam ring structure of the antibiotic rendering it harmless. The tetracyclines are rendered ineffective by the second resistance mechanism whereby the bacteria methylate the amino acid sequence on the 30S subunit of the ribosome that is the binding site of the antibiotic or pumping the antibiotics out of the cell. The fluorquinolone antibiotics inhibit the DNA gyrase of bacteria, thus preventing DNA replication. It has been found that the mechanism of resistance to fluorquinolones is a single point mutation in the gene coding the DNA gyrase, which results in a single spe-

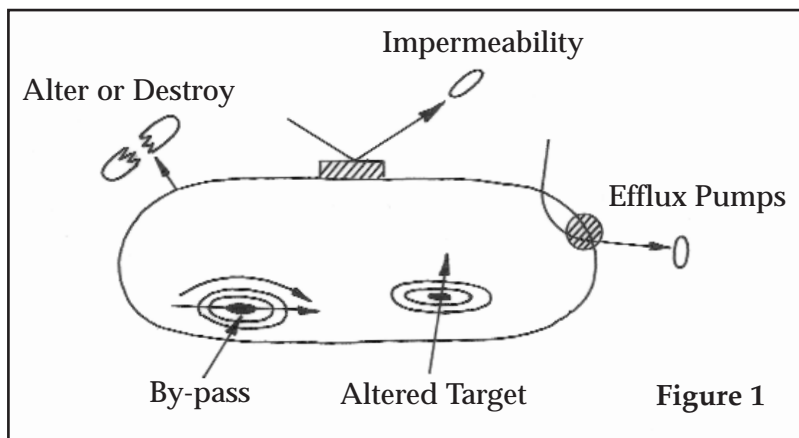


Figure 1

Broiler Whole Bird Condemnation (Region)

	SW	Mid-West	S. East	Mid-Atlantic	S. Central
% Septox	0.270	0.322	0.238	0.218	0.174
% Airsac	0.099	0.091	0.078	0.067	0.057
% I.P.	0.048	0.054	0.034	0.031	0.090
% Leukosis	0.003	0.003	0.003	0.012	0.002
% Bruise	0.008	0.007	0.009	0.007	0.010
% Other	0.039	0.003	0.015	0.004	0.013
% Total	0.467	0.480	0.277	0.339	0.345
% 1/2 parts condemnations	0.380	0.418	0.328	0.362	0.458

Data for week ending 08/24/02

Broiler Performance Data (Company) Live Production Cost

	Average Co.	Top 25%
Feed cost/ton w/o color (\$)	139.91	130.61
Feed cost/lb meat (¢)	13.06	13.00
Days to 4.6 lbs	45	44
Chick cost/lb (¢)	3.96	3.57
Vac-Med cost/lb (¢)	0.05	0.03
WB & 1/2 parts condemn. cost/lb	0.17	0.15
% mortality	4.28	3.61
Sq. Ft. @ placement	0.80	0.79
Lbs./Sq. Ft.	6.38	6.36
Down time (days)	12	13

Data for week ending 08/24/02

cific amino acid substitution. This substitution does not alter the functional ability of the DNA gyrase, but does abolish the inhibition of the enzyme by fluorquinolones. A second point mutation that results in a second, specific amino acid substitution will confer high-level resistance to fluorquinolones without altering the function of the enzyme. Resistance to the fluorquinolones is not transferred to other bacteria. Alterations in the outer membrane proteins (OMPs) that selectively allow passage of molecules into the periplasmic space will also alter the cells permeability to antimicrobials. The acquisition of genes encoding efflux pumps can confer multi-drug resistance to a cell depending on the type of efflux pump acquired. This mechanism works by removing the antimicrobial from the cell before it has time to reach its' intercellular target. The last mechanism of resistance renders resistance to the sulfa antibiotics. Sulfonamides are structural analogs of the substrate of the pathway producing tetrahydrofolate, needed for the production of formyl methionine in bacteria.

Trimethoprim acts as a competitive inhibitor in this pathway. Resistance to the sulfa drugs occurs when mutations in enzymes in the pathway render them less inhibited by the analog, or if the bacteria produce levels of pathway enzymes in excess of the inhibitor.

How Resistance Genes Are Transferred

These resistance genes can be transferred to other bacteria in a number of ways (figure 2). Plasmids, extrachromosomal DNA, can carry resistance genes directly, or they can carry transposons containing resistance genes, or integrons containing resistance genes. Broad host-range plasmids can transfer genes between a variety of bacteria. Transposons themselves can contain integrons having resistance genes. Transposons can be transferred on the plasmid during conjugation or plasmid partitioning during fission. However, there are transposons capable of moving from cell-to-cell without the assistance of plasmids. Resistance to the fluorquinolones is not transferable to other bacteria. Once inside the cell, transposons can move from the plasmid and integrate into the chromosome. When the transposon excises from the chromosomal DNA it can leave behind the resistance gene. Although integrons will only move with the transposons or plasmids which contain them, they can acquire individual resistance genes in the form of circular gene cassettes which can be transferred by themselves between bacteria during conjugation. By sequentially acquiring resistance genes integrons can construct unique multi-drug resistance operons. Bacteriophage, bacterial viruses, can introduce resistance genes into bacteria via transduction. When the phage excise from the chromosome they can leave behind resistance genes. A more rare event is transformation, whereby certain bacteria take up naked DNA from the environment. The science of bacterial genetics and antibiotic resistance is becoming more precise. Almost every day we discover new integrons and transposons that are enabling the bacteria to survive in the presence of therapeutic levels of antibiotics. It is felt that by understanding the actual mechanisms of antibiotic resistance we will be able to understand how to maintain our limited arsenal of antibiotics to combat bacterial infections in both humans and animals.

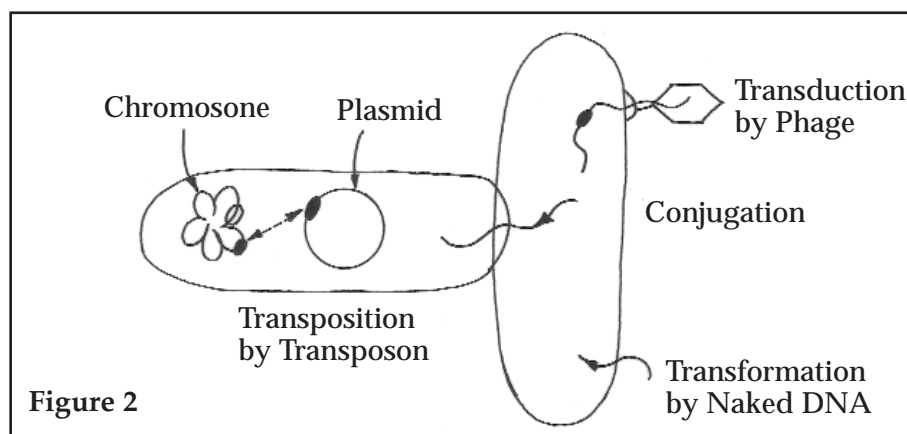


Figure 2



George N. Rowland, professor emeritus, is dead at 64

Athens, Georgia — Dr. George N. (Buck) Rowland III, avian medicine professor emeritus, passed away on September 6, only a year after his retirement from the UGA College of Veterinary Medicine.

An expert in bone pathology, Dr. Rowland was on the College faculty for 25 years, working primarily in the Poultry Diagnostic and Research Center with a joint appointment in the Pathology Department.

“Some of Dr. Rowland's greatest contributions were his mentorship of graduate students and his willingness to collaborate with researchers throughout the College, the University, the country, and the world,” said Dean Keith W. Prasse.

Dr. Rowland taught both DVM students and graduate students working toward a Master of Avian Medicine degree.

“He was very active in diagnostic histopathology,” said Dr. Stanley Kleven, professor and head, Department of Avian Medicine. “Dr. Rowland also took the leadership in our ratite research center, dealing with diseases of ostriches and emus.”

“He was one of the true experts on bone pathology. People consulted him when they had diagnostic problems or needed help with their research,” Dr. Kleven added.

Dr. Rowland received his BA from Miami University and his DVM, MS, and PhD degrees from The Ohio State University.

He is survived by his wife, Ruth E. Rowland, two daughters, and three grandsons.

REMINDER

All previous issues of the Poultry Informed Professional are archived on our website www.avian.uga.edu under the Online Documents and The Poultry Informed Professional links.

FOR YOUR INFORMATION

Bayer has launced a website that will keep you informed of the Notice of Opportunity of Hearing proceedings with FDA to withdraw Baytril from the U.S. market. The site gives the science behind Bayer's defence of Baytril as a tool in poultry production. It will be continually up-dated. The address is www.healthypoultry.com

Broiler Whole Bird Condemnation (Company)

	Average Co.	Top 25%
% Septox	0.213	0.256
% Airsac	0.074	0.070
% I.P.	0.054	0.064
% Leukosis	0.006	0.004
% Bruise	0.008	0.010
% Other	0.016	0.003
% Total	0.371	0.407
% 1/2 parts condemnations	0.393	0.376

Data for week ending 08/24/02



The University of Georgia is committed to the principle of affirmative action and shall not discriminate against otherwise qualified persons on the basis of race, color, religion, national origin, sex, age, physical or mental handicap, disability, or veteran's status in its recruitment, admissions, employment, facility and program accessibility, or services.

The Poultry Informed Professional Newsletter is published with support from Bayer Corporation

Excerpts from the latest USDA National Agricultural Statistics Service (NASS) "Broiler Hatchery," "Chicken and Eggs" and "Turkey Hatchery" Reports and Economic Research Service (ERS) "Livestock, Dairy and Poultry Situation Outlook" Reports

cent from the total average number of layers during July 2001. July egg production per 100 layers was 2,190 eggs, up 1 percent from the 2,166 eggs in July 2001.

All layers in the U.S. on August 1, 2002, totaled 336 million, up 1 percent from a year ago. The 336 million layers consisted of 276 million layers producing table or commercial type eggs, 56.5 million layers producing broiler-type hatching eggs, and 2.67 million layers producing egg-type hatching eggs. Rate of lay per day on August 1, 2002, averaged 70.3 eggs per 100 layers, up 1 percent from a year ago.

Laying flocks in the 30 major egg producing States produced 6.88 billion eggs during July 2002, up 2 percent from a year ago. The average number of layers during July, at 314 million, was up 1 percent from a year ago.

Egg-Type Chicks Hatched Down 9 Percent

Egg-type chicks hatched during July totaled 35.2 million, down 9 percent from July 2001. Eggs in incubators totaled 33.2 million on August 1, 2002, up 11 percent from a year ago.

Domestic placements of egg-type pullet chicks for future hatchery supply flocks by leading breeders totaled 282,000 during July 2002, down 17 percent from July 2001.

Broiler Hatch Up 2 Percent

The July 2002 hatch of broiler-type chicks, at 781 million, was up 2 percent from July of the previous year. There were 645 million eggs in incubators on August 1, 2002, up 1 percent from a year earlier.

Leading breeders placed 6.6 million broiler-type pullet chicks for future domestic hatchery supply flocks during July 2002, up 4 percent from July 2001.

Turkey Eggs in Incubators on August 1 Up 1 Percent

Turkey eggs in incubators on August 1, 2002, in the United States totaled 32.1 million, up 1 percent from August 1 a year ago. Eggs in incubators were 1 percent below the July 1 total of 32.4 million. Regional changes from the previous year were: East North Central, up 6 percent; West North Central, up 7 percent; North and South Atlantic, down 8 percent; South Central, up slightly; and West, up 4 percent.

Poults Placed During July Down 5 Percent From Last Year

The 25.7 million poults placed during July 2002 in the United States were down 5 percent from the number placed during the same month a year ago. Placements were up 5 percent from the June 2002 total of 24.4 million. Regional changes from the previous year were: East North Central, up 10 percent; West North Central, up 1 percent; North and South Atlantic, down 11 percent; South Central, down 6 percent; and West, down 20 percent.

Broiler Eggs Set in 19 Selected States Up Slightly

According to the latest National Agricultural Statistics Service (NASS) reports, commercial hatcheries in the 19-State weekly program set 205 million eggs in incubators during the week ending August 31, 2002. This was up slightly from the eggs set the corresponding week a year earlier. Average hatchability for chicks hatched during the week was 82 percent. Average hatchability is calculated by dividing chicks hatched during the week by eggs set three weeks earlier.

Broiler Chicks Placed Up 1 Percent

Broiler growers in the 19-State weekly program placed 167 million chicks for meat production during the week ending August 31, 2002. Placements were up 1 percent from the comparable week in 2001. Cumulative placements from December 30, 2001 through August 31, 2002 were 5.94 billion.

July Egg Production Up 2 Percent

U.S. egg production totaled 7.34 billion during July 2002, up 2 percent from last year. Production included 6.24 billion table eggs and 1.10 billion hatching eggs, of which 1.04 billion were broiler-type and 62.0 million were egg-type. The total number of layers during July 2002 averaged 335 million, up 1 percent from July 2001.

Broiler Production Up 4 Percent

According to the latest Economic Research Service reports, broiler production during the first half of 2002 was 16.1 billion pounds, 3.6 percent higher than during the same period in 2001. The production increase during the second quarter was 2.9 percent. Most of the increase in the second quarter came from heavier birds as the number of birds slaughtered in the second quarter was up only 1.4 percent. Production is expected to slow somewhat in the second half of 2002 due to large supplies of competing meats and the uncertainty continuing to surround the broiler export market.

Broiler Exports Down, Uncertainty Prevails

Over the first 5 months of 2002, broiler exports were 1.9 billion pounds, down 18 percent from the same period in 2001. The chief reason for the lower shipments was the ban on shipments to Russia. Exports to Russia were 597 million pounds, 31 percent lower than the previous year. While shipments to Russia were substantially lower, a lower demand for imported broiler products in China and the off-again, on-again ban on poultry shipments to Japan were also major factors. Partially offsetting these declines in exports has been strong growth in shipments to Mexico and Korea encouraged by lower parts prices starting in March. Shipments to Mexico were 20 percent higher than the previous year and shipments to Korea were 50 percent higher.

The current outlook for U.S. broiler exports over the second half of 2002 remains uncertain. Negotiations with the Russian Government over the new regulations and procedures governing poultry trade there have not been finalized. While U.S. processors are anxious to resume shipping to Russia, they are also wary of committing products to that market before all the negotiations have been finalized and all new shipping regulations are known. In 2001, direct shipments to Russia accounted for approximately 40 percent of all U.S. broiler exports. The protracted negotiations with Russia are the chief factor behind a 100-million-pound decrease in the broiler export forecast for the third quarter of 2002. The forecast for 2002 stands at 4.7 billion pounds, down 15 percent from the 5.6 billion pounds shipped in 2001. In 2003, with expectations of a successful close to the Russian negotiations, exports are expected to total 5.4 billion pounds.

Turkey Production Up 4 Percent in First-Half 2002 Turkey production over the first 6 months of 2002 was 2.8 billion pounds, a 4.3-percent increase over the same period in 2001. The increase in production is the result of a 2.1-percent increase in the number of turkeys slaughtered, plus an increase of 2.1 percent in the average weight. The forecast for the second half of 2002 is for no growth in production compared with the previous year. The numbers of poult placed for growout during the second quarter of 2002 was 76 million. This is a 3.4-percent decline compared with the previous year.

Turkey Exports 4 Percent Higher

Over the first 5 months of 2002, U.S. turkey exports have totaled 206 million pounds, up nearly 4 percent compared with the previous year. The ban on poultry shipments to Russia has pushed exports to that market down by 56 percent compared with the previous year. However, higher demand in Mexico and Hong Kong more than offset the decline in shipments to Russia. Shipments to Mexico have totaled 100 million pounds, a 20-percent increase, and exports to Hong Kong have risen by 131 percent. Exports to Hong Kong through May totaled 33 million pounds, only 3 million pounds less than was shipped in all of 2001.

Meetings, Seminars and Conventions

2002 September

Sept. 24-25: *Georgia Poultry Conference*, Classic Center, Athens, GA. Contact: Dr. Dan Cunningham, Dept. of Poultry Science, 226 Poultry Science Building, University of Georgia, Athens, GA 30602-4356. Phone: 706-542-1325

Sept. 24-26: *VIV América Latina*, Sao Paulo, Brazil. Contact: Royal Dutch Jaarbeurs, P.O. Box 8500, 3503 RM Utrecht, the Netherlands. Phone: +31 30 295 57 09; Fax: +31 30 295 57 09; Email: viv.america.latina@jaarbeursutrecht.nl

Sept. 24-26: *VIV/AFIA Feed*, Sao Paulo, Brazil. Contact: Royal Dutch Jaarbeurs, P.O. Box 8500, 3503 RM Utrecht, the Netherlands.

Phone: +31 30 295 57 09; Fax: +31 30 295 57 09; Email: viv.feed@jaarbeursutrecht.nl

Sept. 27-28: *Louisiana Poultry Federation's 45th Annual Convention*, Sheraton Shreveport Hotel, Contact: LA Poultry Federation, 224 Knapp Hall LSU, P.O. Box 25100, Baton Rouge, LA 70894-5100. Phone: 225-578-6702; Fax: 225-578-4857.

2002 October

Oct. 1-2: *Alabama Broiler Workshop*, Alabama Poultry & Egg Assoc. Auburn University Hotel & Dixon Conference Center, Auburn University, AL. Contact: Wanda Linker, P.O. Box 240, Montgomery, AL 36101-0240. Phone: 334-265-2732; Fax: 334-265-0008.

Oct. 1-4: *XVII Central American and Caribbean Poultry Congress*, Havana Convention Palace, Havana, Cuba. Contact: Dra. Myriam Perez, Poultry Research Institute, Gaveta Postal No. 1, Santiago de las Vegas, Havana, CP17200, Cuba. Phone 537-579-040. Fax: 537-579-080 or Email: viican@ceniai.inf.cu

Oct. 6-10: *7th WPSA Asian Pacific Federation Conference*, Conrad Jupiter's Hotel, Gold coast, Queensland, Australia. In conjunction with 12th Australian Poultry & Feed Convention. Hotel Conrad, Jupiters Casino, Gold Coast, Queensland, Australia. Contact: APFC 2002 Conference Managers, GPO Box 128, Sydney, NSW 2001, Australia. Phone: +61 2 9262 2277; Fax: +61 2 9262 3135; E-mail: apfc2002@tourhosts.com.au; Internet: <http://www.tourhosts.com.au/apfc2002>

Oct. 6-11: *3rd International Workshop on the Molecular Pathogenesis of Marek's Disease and the Avian Immunology Research Group Meeting*, Limassol, Cyprus. Contact: MAREKS-AIRG at Target Tours, P.O. Box 29041, Tel Aviv 61290, Israel. Phone: +972 3 5175150; Fax: +972 3 5175155; E-mail: mareks-airg@targetconf.com

Oct. 8: *Delmarva Poultry Industry, Inc.*, Annual Membership Meeting, Delmar, Maryland. Contact: Lori Morrow. Phone 302-856-9037.

Oct. 8-10: *Poultry Service Industry Workshop*, The Banff Centre, Banff, Alberta, Canada. Contact: Karen Mann, Safe Food Assurance Systems Branch, 3rd Floor, O.S. Longman Building, 6909-116 St., Edmonton, Alberta, T6H 4P2, Canada. Packages ready in July 2002. Phone: 780-427-6629; Fax: 780-427-1437. Email: karen.mann@gov.ab.ca

Oct. 9-11: *National Meeting on Poultry Health & Processing*, Clarion Resort Fountainbleau Hotel, Ocean City, Maryland, USA. Contact: Karen Adams, Delmarva Poultry Industry, Inc., 16686 County Seat Highway, Georgetown, DE 19947-4881. Phone: 302-856-9037; Fax: 302-856-1845.

Oct. 16-20: *National Chicken Council's 48th Annual Conference & Fall Board of Directors Meeting*, JW Marriott Hotel, Washington, D.C. National Chicken Council, 1015 15th St. NW, Ste. 930, Washington, D.C. 20005-2605. Phone: 202-296-2622.

Oct. 29: *Carolina Feed Industry Assoc.*, Feed Production Technology School, Sheraton Imperial Hotel, Research Triangle Park, Raleigh, NC. Contact: Owen Robertson, 2116 N. Shoreline Dr., Sanford, NC 27330. Phone: 919-776-3054.

Oct. 31: *Carolina Feed Industry Assoc.*, Poultry Nutrition Conference, Sheraton Imperial Hotel, Research Triangle Park, Raleigh, NC. Contact: Owen Robertson, 2116 N. Shoreline Dr., Sanford, NC 27330. Phone: 919-776-3054.

2002 November

Nov 12-13: *Alabama Breeder/Hatchery Workshop*, Alabama Poultry & Egg Assoc. Auburn University Hotel & Dixon Conference Center, Auburn University, AL. Contact: Wanda Linker, P.O. Box 240, Montgomery, AL 36101-0240. Phone: 334-265-2732; Fax: 334-265-0008.

Nov 12-15: *EUROTIER 2002*, Hanover, Germany. Contact: German Agricultural Society, Eschborner Landstr. 122, D-60489 Frankfurt am Main, Germany. Phone 49-0-69-24788-259. <http://www.eurotier.de>

Nov 26-29: *EXPOAVIGA 2002*, Mantjuic 2 Trade Fair Centre, Barcelona, Spain. Contact: Fira de Barcelona. Phone: 34-932-332-358.

2003 January

January 22-24: *International Poultry Exposition*, Georgia World Congress Center, Atlanta, GA. Contact: U.S. Poultry and Egg Association, 1530 Cooledge Road, Tucker, GA 30084. Phone: 770-493-9401; Fax: 770-493-9527

2003 March

March 8: *ACPV Sponsored Workshop, Molecular Biology Made Easy*, Contact: H.L. Shivaprasad, 2789 S. Orange Ave., Fresno, CA 93725. Email:

March 9-11: *52nd Western Poultry Disease Conference*, Capitol Plaza Holiday Inn, Sacramento, CA. Contact: R.P. Chin, 2789 S. Orange Ave., Fresno, CA 93725

2003 July

July 19-23: *XIII Congress of the World Veterinary Poultry Association*, Denver, CO, USA. Contact: Details are posted on the web site of the American Association of Avian Pathologists. Website: <http://www.avian.uga.edu/~wvpa/>