Courtney Purvis

For many years, agricultural institutions have relied on atrazine as a powerful herbicide primarily used for corn, but also on a large number of less prolific crops. It is so widely used as a pesticide that traces of atrazine have been found in over two thirds of the bodies of water in the United States *PANNA*! due to significant runoff from irrigation. "trazine is produced by a champion of the agribusiness industry #nown as Syngenta. $r. %yrone &. 'ayes, a researcher from the University of California at &er#eley, has presented evidence that atrazine is a carcinogen in the reproductive system and a hormonally active agent due to its chemical property to interrupt the endocrine system. 'ayes(s research focuses primarily on atrazine(s effects on amphibians, specifically hermaphroditism in frogs. 'owever, Syngenta(s head researcher, $r. Peter 'ertl, has contested $r. 'ayes(s findings and)uestioned the validity of his research 'ertl!. $espite $r. 'ertl(s re*ection of $r. 'ayes(s research and the doubts of its scientific merit, there is significant evidence that suggests that atrazine is a dangerous endocrine disruptor and is a significant environmental hazard. +hile 'ertl challenges 'ayes(s results, there is greater reason to)uestion 'ertl(s motives.

,ecently, the significant decline in the "frican frog *Xenopus laevis)* population in southern California prompted $r. %yrone &. 'ayes to conduct a study to clarify the effects of atrazine in the hormones and reproductive organs of maturing male frogs. 'e hypothesized that the rapid decline was lin#ed to the increasing presence of atrazine in their environment. 'ayes began conducting e-periments by introducing atrazine in ../ parts per billion to forty male frogs. 0ut of the total raised, 123 of the testing population e-perienced decreased hormone levels of testosterone and decreased fertility,

meaning that they are less li#ely to reproduce in nature. %he remaining four frogs, or 42 3 of the testing population, did not possess nuptial pads on the lower arms, but had cloacal labia, meaning they were now effectively female. ' ayes observed that the hermaphroditic frogs also had an increased amount of aromatase, the enzyme which is responsible for changing testosterone to estrogen. 0f these hermaphrodites, two were mated with other atrazine5e-posed males and bore offspring while the other two were dissected and e-amined. + hile surveying the frogs(anatomy, ' ayes discovered that even though they were chromosomal males, after being e-posed to atrazine, the frogs had been physically and chemically converted into females. In addition, all of the offspring from 6atrazine5induced females7 were males ' ayes, et al. 894.!. If atrazine is already affecting frogs at low concentrations, because concentrations are occurring in greater numbers in the wild, it is li#ely that ' ayes(s results would prove correct for other species over time.

' ayes(s most recent e-periment on atrazine titled 6" trazine Induces Complete Feminization and Chemical Castration in : ale " frican Clawed Frogs ; enopus <aevis!,7 which was published in the Proceedings of the =ational " cademy of the Sciences, is under scrutiny. Syngenta(s head of >lobal Product Safety, $r. Peter ' ertl, wrote a letter critical of ' ayes to the University of California at &er#eley and to the president of the =ational " cademy of Sciences stating the inade)uacies of ' ayes(s report. ' ertl made few correct accusations. First, he argues that there was no control population to compare outcomes of similar se-ual growth. ?et ' ayes(s study includes a control group of forty male " frican clawed frogs ' ayes, et al. 894.!. Secondly, he claims that not all the methods and procedures of the e-periment were included ' ertl!, which also means that ' ayes did not follow the standard >ood <aboratory Practices *Nebraska Corn Kernels*!. + hen e-amining ' ayes(s methods and results, the reader will find a complete demonstration of the e-periments and a supported conclusion. Finally, ' ertl claims that e-periment tested only one dosage of atrazine on frogs that were constantly handled by scientists. It is true that only one dosage of ../ ppb parts per billion! of atrazine were applied to the

test population, which might *eopardize the accuracy of the e-periment. ' owever, ' ayes uses ../ ppb as the current testing environment(s saturation of atrazine because it is a relatively small concentration compared to the @P"(s allowed ma-imum concentration of A.2 ppb. It is even possible that the actual presence in certain areas in nature could be much larger. &ecause the test produces such adverse effects at such a small dosage there is concern for the possibility that more severe and human5related conse)uences could occur. %herefore, the test only needs one dosage to determine atrazine(s potential to-icity because ' ayes is determining the minimal effects of atrazine. If this miniscule dosage of ../ ppb is enough to endanger a population of frogs, then there(s no way of measuring the imminent, mass infliction atrazine can cause in larger dosages to wild populations.

+ hile the dangers of atrazine are being debated, both men fail to mention a recurring phenomenon in frogs which could greatly alter atrazine research. It has been found that under e-treme environmental pressure, various amphibians and most frogs are capable of changing se-es. ' eterogamety is when two different se- chromosomes are formed in one gender. For instance, human females have two (;(se- chromosomes while the males have an (;(and a (?(chromosome, so the heterogametic se- is male. It is the heterogametic se- that is capable of disintegrating its current reproductive organs and growing functional reproductive organs of the opposite se-. In amphibians, heterogamety depends on the species, which neither $r. ' ayes nor $r. ' ertl addresses 0gata, et al. 94A!. In ' ayes(s e-periment, there are forty males in a single containment unit where members of the population are being e-posed to a chemical and being handled by men with absolutely no women around. It seems as though this would be enough environmental stress to cause a male to change into a female to allow the population to survive, but because forty out of forty control frogs remained males during the testing, it shows that not even e-cessive handling and lab procedures will spar# the transformation. 0nce again $r. ' ayes(s evidence stands.

+ hile $r. ' ayes is battling $r. ' ertl(s proclamations to reinstate his integrity, the company

financially bac#ing $r. 'ertl has larger things at sta#e. Syngenta(s largest concern in regard to the situation is that atrazine was un*ustly vilified by 'ayes(s data. "trazine is Syngenta(s highest source of revenue 'ayes!. Syngenta is a mega5corporation that has millions invested in a hardy pesticide that brings loyal consumers and provides thousands of *obs. "trazine is used in the ma*ority of the United States and many farmers currently depend on it for the success of their crop yield 6Frogs7!. $r. 'ertl(s chec# is paid by Syngenta, while 'ayes is funded by several organizations that reward education and meritB such as the California %o-ic Substances ,esearch and %eaching Program, the $avid foundation, and the =ational Science Foundation. %he research that has been called into)uestion by Syngenta was published in the Proceedings of the =ational "cademy of the Sciences, which even the leading scientist against 'ayes admitted 6has a long history of publishing peer reviewed scientific papers of a high standard7 'ertl!. :oreover, in 411C, $r. 'ayes was wor#ing in research for a company #nown as =ovartis, where he discovered the possible hazards of atrazine. Instead of investigating the findings, the company restricted 'ayes from spreading his research through conventions or by publishing the information. 'e then)uit his position to research atrazine on his own terms. 'ayes admits that the chemical company had greatly 6hindered7 his efforts to reenact the e-periment 'ayes!.

%hree years later on =ovember 4A, .222, =ovartis *oined "straDeneca to form Syngenta *Syngenta*!. "s a small company, =ovartis prevented 'ayes from not only finding the actual repercussions of the herbicide, but also from sharing his wor# with the scientific community. =ow as a multi5billion dollar corporation, Syngenta is doing all in their power to #eep their best product on the mar#et.

+or#s CitedE

F"trazineE Syngenta(s 'erbicide.F *Pesticide Action Network North America (PANNA)*. +eb. A4 "ug. .242. GhttpEHHwww.panna.orgHatrazineI.

FCompany ' istory.F *Syngenta*. +eb. 24 "ug. .242. GhttpEHHwww..syngenta.comHenHaboutJsyngentaHcompanyhistory.htmlI.

FFrogs, "trazine and the =utty Professor.F *Nebraska Corn Kernels*. 4. "ug. .242. +eb. .A "ug. .242. GhttpEHHnebras#acorn.blogspot.comH.242H2KHfrogs5atrazine5and5nutty5professor.htmlI.

'ayes, %yrone &. F0ur +orld...0ur Future.F *Atrazinelovers*. +eb. .A "ug. .242. GhttpEHHwww.atrazinelovers.comHm2.htmlI.

'ayes, %yrone &., L. Mhoury, ". =arayan, :. =azir, ". Par#, %. &rown, <. "dame, @. Chan, $. &uchholz, %. Stueve, and S. >allipeau. F"trazine Induces Complete Feminization and Chemical Castration in :ale "frican Clawed Frogs ;enopus <aevis!.F *Proceedings of the National Academny of the Sciences (PNAS)* 42th ser. 42C .242!E 894.594C. +eb.

'ertl, Peter. <etter to $r. ,alph N. Cicerone and $r. ,andy Sche#man. 4 Nune .242. *Atrazine Herbicide*. Syngenta. +eb. .9 "ug. .242. GhttpEHHwww.atrazine.comH"mphibiansHhayesJanalysis.pdfI.

Maleita, "my. F@nvironmentalist %urns to @5bullying.F *Washington Times*. 44 "ug. .242. +eb. .A Sept. .242. GhttpEHHwww.washingtontimes.comHnewsH.242HaugH44HenvironmentalistHturnsHtoHeH bullyingHI.

0gata, :., '. 0htani, %. Igarashi, ?. 'asegawa, ?. Ichi#awa, and I. :uira. FChange of the 'eterogametic Se- From :ale to Female in the Frog.F *Genetics* 498 .22A!E 94A5.2. *The Genetics Society of America*. +eb. 9 $ec. .242. GhttpEHHeasybib.comHciteHformHwebsiteI.