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A Retrospect on Achievements Following an Onerous Retraction

Baker, R. J., R. A. Van Den Bussche, A. J. Wright, L. E. Wiggins, M. J. Hamilton, E. P. Reat, M. H. Smith, M. D. Lomakin, and R. K. Chesser. 1996. "High levels of genetic change in rodents of Chernobyl." Nature no. 380 (6576):707-8. doi: 10.1038/380707a0.

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Scientific progress is accomplished by a process of elucidation through validated methods and repeated verification. Retraction of a scientific paper may, in some instances, be the most appropriate action if authors determine that their conclusions were incorrect and no alternative avenue of communication is available.

Scientific papers are a result of observations based on the scientific method. The process of designing, writing, and submitting a scientific paper rarely involves concerns about a need for retraction of conclusions. Our study on the mutation rate in developing embryos in voles living in the Red Forest near Chernobyl certainly did not involve discussions or concerns about the possibility of a retraction (Baker et al. 1997, Baker, Van Den Bussche, et al. 1996). Yet that was the ultimate outcome of our cover article published in *Nature* on April 25th, 1996.

One of the most radioactive regions in the world was created by the 1986 meltdown of Reactor 4 at Chernobyl. The goal of our study was to use the most sophisticated scientific methods available to test the mutation rate in the mitochondrial Cytochrome-*b* gene of embryos from mothers living in the most radioactive regions compared to embryos of females from regions free of radioactive contamination. We cloned the Cytochrome-*b* gene in a plasmid and grew up cloned copies of the gene which were sequenced by the Sanger sequencing method, commonly employed at that time. This method is a chain termination sequencing method based on the use of labeled dideoxynucleotides (which result in sequence termination when incorporated) as well as the normal deoxynucleotides. The chain termination fragments for each radioactive nucleotide (A, T, G, C) are size separated in individual lanes using gel electrophoresis. Using electrical current, the different nucleotides are run on four electrophoretic lanes which produced a signal for each specific nucleotide. Polyacrylamide gels containing the radioactively labeled fragments were dried and exposure on large sheets of film produced a measurable order of nucleotide sequence for the specific gene. This procedure obviously has an error rate, but many scientific papers have used this procedure to generate publishable data that were never retracted. Our results had statistical support, were fairly easy to interpret, and our

conclusions merited publication in an outstanding journal like *Nature*. Our paper was reviewed with support for publication and was quickly published in *Nature* to beat the deadline for the anniversary of the meltdown.

Dr. Ron Chesser, the one who initiated our Chernobyl efforts, had obtained permission to study the native fauna in the most radioactive region west of Reactor 4, as well as inside the 10K and 30K restricted zones where radiation was often the highest. The 10K and 30K zones refer to the distance, in kilometers, surrounding Reactor 4 in all directions (Fig. 1 in (Baker, Hamilton, et al. 1996)). This was referred to locally as the "zone of alienation" because people were, for the most part, not permitted to live inside this zone. Although approximately 300 residents refused to leave, 135,000 were evacuated from these regions. While we were collecting specimens, no one ever came to question our presence in the most radioactive environment. When our colleagues would ask us "Is it safe to work there?" we would always reply, "Yes it is, we never see any other people there." We obtained export permits for tissues and voucher specimens which are still archived in the Genetic Resources Collection of the Museum of Texas Tech University and are available to be studied today by scientists that meet our loan policies and procedures.

Within a few weeks after we published our paper, we were able to buy a new automated sequencer, an ABI 310 autosequencer. We had archived all of the clones and DNA that were the basis for both the initial and retracted publications. It was relatively easy to produce new, more accurate sequences to test our published results. When we did that, a few of the nucleotide calls using the older method were not supported and additional replications of the sequence verified these new calls. These changes resulted in the lack of statistical support for our original conclusions. Using the new sequencer, we reevaluated our data repeatedly, and assessed error rates. It became obvious that the results generated from the Sanger Sequencing method would not have qualified for publication in *Nature*. The number of mutations in the genes from the embryos exposed to the Chernobyl environment remained higher than in controls, but the differences were not statistically significant.

Fortunately, elucidation of the problem was the result of our own diligence rather than by researchers from separate laboratories. If we had destroyed the archived material, which is a common practice after a study is published, no evidence of errors would have been immediately realized. Texas Tech had established a policy to archive all frozen tissues from Chernobyl animals to provide options for future explorations as new techniques became available. In fact, the decision to reevaluate the data from the published work was intended as validation for extended investigation of radiation effects using updated methods. Our diligence, however, now presented a dilemma for the authors. At this point there was no doubt that our primary inference of high mutation rates in Chernobyl rodents was not statistically supported by the revised data. We considered the option of publishing a separate study that clarified how our new results were counter to those published in *Nature*. We realized, however, that the cover story in *Nature* would likely remain as the foremost citation in subsequent literature and that our paper may mislead others regarding the controversial subject of radiation effects. Further, we concluded that science only works if there is honesty in the methodologies and results. Using these standards, we decided that retraction of the manuscript would be the most appropriate action. The retraction had three major negative consequences for the authors and the research program. First, was the loss of credibility resulting from publishing a cover story in *Nature*. Second, part of our team had submitted an NIH (National Institute of Health) proposal and the conclusions of the *Nature* paper were at the center of the experimental design. We withdrew that proposal from consideration. Third, several of the authors considered choosing alternative careers outside of academia and education.

When the retraction appeared in *Nature*, the lead author, RJB, was informed that some faculty at Texas Tech University had written letters to the higher administration requesting that RJB be fired because the retraction had damaged the university's reputation. The Vice President for Research was supportive of our action to retract and stated that he knew he had at least a few honest faculty members. RJB felt guilty for not doing sufficient replicates and tests to determine that the data were questionable. For a window of several months, he considered getting out of science and resigning from

the university and finding a non-academic position. The strongest support, for RJB remaining a professor and mentor of students, came from the contemporary group of students that were at Texas Tech at that time. RJB really appreciated their support and has published a substantial number of papers since the retraction. Before submission of a new paper, RJB always spends time thinking "Is there something here that might indicate a future need for a retraction?" This documents how powerful a negative atmosphere results from having to retract a paper in such a prominent journal as *Nature*.

The author line of the paper above contained three undergraduates (L. E. Wiggins Johnson, E. P. Reat, and A. J. Wright), two Ph.D. students (R. A. Van Den Bussche, M. J. Hamilton), a director of a federal research facility (M. H. Smith), a Ukrainian (M. D. Lomakin), a professor from University of Georgia (R. K. Chesser), and a professor from Texas Tech University (R. J. Baker). During the writing of this article, many co-authors revisited their feeling associated with the retraction. However, we can see that this retraction did not have an ultimate impact on their success as academicians and scientists. How are these people doing today, and what are their positions in science/academia? L. E. Wiggins Johnson has an M.D. from Baylor College of Medicine and is an Associate Professor in the Department of Pediatrics at Texas Tech University Health Sciences Center School of Medicine. E. P. Reat has an M.S. from Purdue University and is the Quality Assurance Manager at the Bexar County Criminal Investigation Laboratory. E. P. Reat is also an adjunct faculty member at the University of Texas at San Antonio. A. J. Wright has a Ph.D. from Harvard and currently an Assistant Professor at the University of North Texas. R. A. Van Den Bussche is an Associate Dean for Research, Regents Professor, Faculty Fellow in the Office of the Vice President for Research and Technology Transfer and Curator of Frozen Tissues at Oklahoma State University. M. J. Hamilton is an Associate Professor at Oklahoma State University, and also holds the position of Faculty Athletic Representative at OSU. M. H. Smith was the director of the Savannah River Ecology Laboratory for several years and a professor at the University of Georgia. M. D. Lomakin was a consultant on Chernobyl affairs for The Ministry of Emergency Situations. R. K. Chesser is a Professor of Biology at Texas Tech University and is Director of the Center for Environmental Radiation Studies. R. J. Baker is Horn Professor in the Biological Sciences, Director of the Natural Science Research Laboratories and Curator of the Genetic Resources Collection at the Museum of Texas Tech University.

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