

TRACKING SPILLS AND RELEASES: HIGH-TECH IN THE COURTROOM

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I. INTRODUCTION

In this day and age of “virtual reality,” many courtroom computer and video presentations are losing the element of credibility. This is due to the public’s awareness of how computer images, animations, and simulations can be manipulated.¹ Constant exposure to movie and

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1. See Andrew Reese, *Forensic Animation Helps Bring Cases to Life in Court* 22 THE LAWYER’S PC 1, 5 (Aug. 15, 1995).

television animation has led the public and jurors to suspect “computer magic” in any extraordinary visual sequence.²

At the same time, there is a trend toward “actual reality” in certain contexts.³ One example is the typical television weather program wherein a weather person will depict the movement of clouds, fronts, and storm systems through the use of three-dimensional imaging techniques. These images are further “authenticated” by references back to satellite images of the actual cloud systems as they move. The repeated references back and forth between the computer-created clouds and the actual cloud systems as seen from satellites convince viewers that everything they are seeing on the screen is real. This method of presentation circumvents the public’s general skepticism toward computer images.

In the courtroom, the ability to enlarge photographs and documents “on the fly” during trial through the use of a computer and television monitors enhances otherwise bland presentations. Computer graphics give the attorney the ability to include the jury in the examination of the evidence with the witness. One commentator has noted a 1990 study showing “that jurors retain more than fifty percent more information when it is presented in multimedia form.”⁴ Another commentator has accumulated evidence related to jury impacts and noted that survey results indicate a 100 percent increase in juror retention when a visual, rather than merely oral, presentation was used.⁵ The same commentator noted that juror retention increased 650 percent when both a visual and an oral presentation was used.⁶ Finally, the commentator noted that “neurophysiologists purport that ‘one-third of the human brain is devoted to vision and visual memory.’”⁷

Traditionally, attorneys have used the standard 8x10 glossy photograph, which is too small for the jury to see during examination of the witness. Alternatively, they have used huge, cumbersome, and

2. See *id.*

3. See *id.*

4. Carole E. Plowman, Comment, *Multimedia in the Courtroom: Valuable Tool or Smoke and Mirrors?*, 15 REV. LITIG. 415, 417 (1996) (quoting Brian D. Handrigan, *Multimedia Isn't the Message—Business Users Are Looking for Substance Rather Than Style*, INFORMATION WEEK, July 19, 1993, at 30).

5. See Julie K. Powell, *Computer Generated Visual Evidence: Does Daubert Make a Difference?*, 12 GA. ST. U. L. REV. 577, 579-80 & n.14-18 (1996).

6. See *id.* at 579 (citing Roy Krieger, *Now Showing at a Courtroom Near You. . .*, A.B.A. J., Dec. 1992, at 92).

7. See *id.* at 579 (quoting Roy Krieger, *Now Showing at a Courtroom Near You. . .*, A.B.A. J., Dec. 1992, at 92).

expensive enlargements. Because it is difficult to determine which photographs and documents will be used during trial, many blowups are made which are never actually used. With the use of computer graphics in the courtroom, the trial attorney is given new persuasive capabilities, including:

(1) The ability to “zoom” or magnify small details of photographic evidence and documents, allowing the jury to focus on the issue under examination and participate in the examination from the jury box. A video writer, which allows the expert or attorney to draw and annotate on the video image, can further focus the concentration of the jury.

(2) The ability to present video clips on demand, eliminating the distracting fast-forward and rewind when searching for a specific segment of the video tape. Video clips can be indexed by any criteria, instantly accessed, and played in any order. This increases the attorney’s ability to keep the jury’s attention when presenting key evidence. Digital video also allows perfect “freeze frame” capability without the “jitters” and horizontal lines created by VCR’s. Combined with the video writer, digital images become a powerful tool for presenting video in the courtroom.

(3) The ability to extract a single frame from a video tape for enlargement and color printing. Computers are capable of enhancing a single video frame for color hard copy. This ability becomes critical when the key evidence is contained in one passing second of the video tape.

(4) The ability to enhance a bad photograph. Too often, a key piece of photographic evidence was taken by someone unfamiliar with the camera equipment being used. Through high resolution scanning of the original negative, image processing software and digital filters may be able to bring out the important details in a bad photograph.

(5) The ability to create professional quality demonstrative exhibits the day before trial, as compared to traditional hard copy which requires preparation weeks in advance. On-the-fly changes allow data to be manipulated and presented even while the trial is underway. Composites of photography, computer graphics, and annotations can make powerful visual summaries of a multitude of independent facts.

(6) The ability to create computer-generated three-dimensional scale models from engineering drawings, CAD (Computer-Aided Design) files, and photographs. The computer allows the jurors to view an accurate depiction of an object or group of objects from any

perspective. Motion data can be applied to accurately depict a sequence of events. Transparency can be used to reveal the internal workings or structures of an object. Textures can be used to enhance the detail of an object, resulting in a photo-realistic depiction. Three-dimensional animation is a valuable tool when multiple perspectives of a single event are required. Two-dimensional animation is an economical alternative when a single flat perspective is sufficient.

(7) The ability to re-create an event that occurred in the past. Using the data from a reconstruction analysis, computers can recreate events to depict an expert's opinion in a clear and concise manner. This technique can be applied to vehicular, maritime, and aviation accidents. It is also useful in explaining the instigation and propagation of a fire or explosion.

(8) The ability to accurately re-create an object that no longer exists, or does not exist in its original form. Special techniques allow extraction of three dimensional information from two dimensional imagery. For instance, utilizing multiple photographs of a post-collision vehicle taken from different perspectives, a three-dimensional model of the damaged vehicle can be constructed to obtain dimensions and damage information. This technique can be applied to any object or scene where multiple perspective photographs are available.

(9) The ability to immediately access any part of the presentation, including video, audio, photographs, documents, computer graphics, and animation. Multimedia allows the jury to maintain perspective during the presentation of interrelated pieces of evidence from multiple formats. Moreover, the interactive ability of multimedia can enhance and direct the correlation of all components in the visual presentation of a particular case.

As to the practical and legal applications in the courtroom, computer presentations generally take the form of two types of evidence: "(1) recreations, which purport to simulate an event and (2) animations that are not precise recreations, but simply illustrate opinion, such as an expert's theory of the case, or a scientific principle."⁸ These types of presentations usually involve a significant or detailed predicate and foundation, particularly in the case of simulations, and consequently can fall prey to certain discovery pitfalls or trial objections.

8. William F. Lee & Lisa J. Pirozzolo, *Using Computer-Generated Evidence at Trial*, 523 *PLI/Lit* 159, at 165-66 (1995).

A third type of computer graphics presentation is the focus of this paper. These presentations often incorporate data from computer plume models, overland-flow models, or similar types of model data and superimpose such data on a backdrop of photographic images of a particular location. This information can thereafter be integrated with a Geographical Information Systems (GIS) database which allows the user to pinpoint with specificity the exact location of the persons, property, or substances at issue in the litigation in relation to the release or spill at issue. This type of evidence can be used effectively in mass torts, class actions, or matters related to spills and releases of noxious substances. The effectiveness of the evidence stems from the realism created by aerial photographs, "real-time" video, or satellite images. As a result, the evidence generally encounters less opposition to admissibility since this evidence closely parallels the realism and authenticity of the weather programs described above.

The following discussion will focus generally on the admissibility of computer evidence, namely animations and simulations, and explore the evidentiary hurdles to the admission of such evidence. The discussion then moves to a consideration of the uses of GIS "tracking" data and its use in conjunction with plume or release modeling. Due to its high degree of reliability, this type of computer generated evidence is much more likely to be admitted.

II. USE OF COMPUTER GENERATED EVIDENCE AT TRIAL: EVIDENTIARY HURDLES

A. *Simulations*

As mentioned above, simulations are recreations of actual incidents or events giving rise to litigation. Since such presentations are basically telling the trier of fact or jury that the incident happened in a particular way, and since computer images are often so "dramatic" that they sometimes are more believable than eye witnesses,⁹ the courts will generally scrutinize simulations and recreations much more closely than mere animation of an expert's opinion. For example, in a Louisiana state court case, *Pino v. Gauthier*, the court refused to admit a videotape simulation depicting four scenarios of possible movement by a truck involved in a vehicular accident.¹⁰ The various scenarios involved the

9. See, e.g., *Robinson v. Missouri Pac. R.R. Co.*, 16 F.3d 1083, 1088 n.4 (10th Cir. 1994) ("[t]he expert opinion evidence for plaintiffs appears to have carried more weight than eyewitness testimony.").

10. *Pino v. Gauthier*, 633 So.2d 638, 652 (La. App. 1st Cir. 1993).

insertion of variables, such as the weight of the vehicle, speed, road conditions, and braking, into a specialized computer program which thereafter reconstructed the motion of the vehicle as it approached the collision.¹¹ In analyzing the admissibility of the simulation, the court of appeals applied a Louisiana evidentiary test normally utilized for videotapes.¹² This test requires the trial court to

[c]onsider whether the videotape accurately depicts what it purports to represent, whether it tends to establish a fact of the proponent's case, and whether it will aid the jury's understanding. Against those factors, the trial court must consider whether the video tape will unfairly prejudice or mislead the jury, confuse the issues, or cause undue delay.¹³

Applying this test of admissibility, the court held that the videotape was inadmissible due to opposing counsel's inability to change any of the variables or to produce an alternative version of the videotape for the jury to view.¹⁴ The court also reasoned that "[i]t was proper to avoid the impact of the jury viewing this specially created tape, containing only favorable outcomes."¹⁵ The court of appeals added that "[i]t was not necessary for the jury to view a computer simulation to understand how a vehicle might lose control during a lane change maneuver."¹⁶

In contrast, in a Florida criminal matter, *State v. Pierce*, prosecutors created a simulation of a hit and run accident through the use of a laser beam technique and a computer program known as CAD to produce thirty-two hundred photos and maps of the crime scene taken from every conceivable angle and based on precise measurements recorded during repeated investigations.¹⁷ This information was thereafter used to create graphic scenes using "Disney-type" techniques which were then run in rapid succession to create the illusion of movement.¹⁸ The court admitted the simulation, but allowed use of the presentation only as an "animation" which, in turn, limited the evidence

11. *See id.*

12. *See id.* (citing *Malbrough v. Wallace*, 594 So.2d 428, 431 (La. App. 1st Cir. 1991)).

13. *Id.* at 652.

14. *Id.*

15. *Id.*

16. *Id.*

17. *See Using Computer Animation in the Courtroom*, PROSECUTOR, Oct. 1995 at 17 (citing *State v. Pierce*, No. 92-193, 16CF10A (Fla. 17th Cir. Ct. 1992)).

18. *See id.*

to demonstrative use or a mere visualization of the expert's accident-reconstruction opinions.¹⁹ Despite scaling down of the use of the evidence, the defendant was convicted.²⁰

In *Hopper v. Crown*, the trial court admitted a simulation of a forklift accident.²¹ On the basis of this and other evidence, the court found that the forklift "was unreasonably dangerous because an alternative design that would produce less harmful consequences was available and the alternative design would have prevented the plaintiff's injuries."²² One of the more convincing sources of evidence was the simulation opposed by the defendant, which explored the issue of whether the forklift should or should not have had a door.²³

The court of appeals affirmed the admission of the forklift simulation based on the fact that the plaintiff's expert "did possess the experience and the academic qualifications necessary to express valid opinions in the fields of forklift design and safety, forklift accidents, injuries and restraints and provided analytical and computer study results to use as a basis for the opinions."²⁴ Plaintiff's expert, a consulting engineer, had based his opinion on his own experience and a computerized simulation video he created of the accident, analyzing the accident using a forklift without a door and with a door.²⁵ The simulation was further bolstered with information from the defendant and the plaintiff as well as photographs and engineering texts. The computer simulation demonstrated that the plaintiff would not have been thrown from the forklift given the forces involved in the collision.²⁶

Such recreations are not always admitted. This is sometimes because they appear to be too real. For example, in *Racz v. R.T. Merryman Trucking Co.*, the plaintiff sought to keep out of evidence a computer animation of the accident prepared by the defendant's expert.²⁷ The issue was whether the back wheels of the tractor-trailer driven by the defendant's employee entered the passing lane while plaintiff's decedent was passing the truck, prompting her to swerve to avoid a collision.²⁸ Relying on the old adage "seeing is believing," the court excluded the

19. *See id.*

20. *See id.*

21. *Hopper v. Crown*, 646 So.2d 933 (La. App. 1st Cir. 1994).

22. *Id.* at 943.

23. *See id.*

24. *Id.* at 945.

25. *See id.* at 937-38

26. *See id.*

27. *Racz v. R.T. Merryman Trucking Co.*, 1994 W.L. 124857 (E.D. Pa. 1994).

28. *See id.*

animated reconstruction of the accident because it appeared the jury might give undue weight to the visual presentation.²⁹ As the court stated:

Because the expert's conclusion would be graphically depicted in a moving and animated form, the viewing of the computer simulation might more readily lead the jury to accept the data and premises underlying the defendant's expert's opinion, and, therefore, to give more weight to such opinion than it might if the jury were forced to evaluate the expert's conclusions in the light of the testimony of all of the witnesses, as generally occurs in such cases.³⁰

The implication of the opinion is that the court viewed the evidence not as a mere animation of an expert's opinion, but as a recreation or simulation of the event. Thus, a greater evidentiary hurdle for re-creations was created by the court.

Another problem can arise where an attempt is made to introduce an animation or illustration of an expert's opinion, but the presentation is based on incorrect facts. In *Guillory v. Domtar Industries*, the court considered an attempt to introduce several forklift animation scenarios.³¹ The court disallowed this evidence, finding that the expert's testimony as well as the animations were based on altered facts and speculation in support of the defendant's position.³² The court's reasoning was based on a finding that the expert's conclusions were "unfounded and misleading" and the fact that the evidence was so "technical" that it would have misled the jury if admitted.³³

Another pitfall for the recreation is that it may simply be ignored. In *ANR Production Company v. Kerr-McGee Corp.*, an oil and gas unit operator attempted to use a simulation in an accident against a drilling company, the suit arising from a case involving the drilling of a well that had caused drainage of hydrocarbons from a unitized zone.³⁴ The action was based on conversion of the hydrocarbons, trespass, breach of contract, and strict liability.³⁵ In connection with the evidence associated with the attempts to quantify the amounts of hydrocarbons which had been drained from the unit, the operator presented testimony from an

29. *Id.*

30. *Id.*

31. *Guillory v. Domtar Indus., Inc.*, 95 F.3d 1320, 1329-31 (5th Cir. 1996).

32. *Id.*

33. *Id.* at 1331.

34. *ANR Prod. Co. v. Kerr-McGee Corp.*, 893 P.2d 698, 699-701 (Wyo. 1995).

35. *See id.*

expert petroleum engineer who utilized a computer reservoir-simulation model to determine the amount of convected hydrocarbons.³⁶ The simulation was admitted. Nevertheless, the court chose to believe the opposing party's consultant who testified without the aid of computer graphics.³⁷ The trial court apparently did not believe the reservoir simulation. This demonstrates that seeing is not always believing in the realm of simulations.

B. Animations

In contrast to simulations, animations of expert opinions are more often readily admitted. A test sometimes used for admissibility is whether: "(1) the computer is functioning properly; (2) the input and underlying equations are sufficiently complete and accurate (and disclosed to the opposing party, so that they may challenge them); and (3) the program is generally accepted by the appropriate community of scientists."³⁸

Usually, animations or illustrations of testimony are admitted because they are generally accepted as demonstrative evidence to merely illustrate an expert's opinion and do not actually become new evidence as do simulations. At the same time, although simulations are often admitted into evidence merely as "animations," they can still have the same powerful effect on the trier of fact had the evidence been admitted as real evidence.

For example, in a Louisiana criminal matter, *State v. Harvey*, the court admitted the state's computer-generated, still-frame animations "depicting a shooting incident and [the] placement of the victim's body."³⁹ The state argued that the animations illustrated the positions of the victim and the defendant in the path of the bullets.⁴⁰ The state also argued that the animations were not inflammatory because there was no blood depicted.⁴¹ To the contrary, the prosecution contended that the animations were simply "demonstrative" of the opinions of the coroner whom the prosecution had called as a primary witness.⁴² In response, the defendant maintained that the animations were inflammatory and

36. *See id.* at 701.

37. *See id.*

38. *Kudlacek v. Fiat, S.P.A.*, 509 N.W.2d 603, 617 (Neb. 1994) (quoting *Commercial Union Ins. Co. v. Boston Edison Co.*, 591 N.E.2d 165, 168 (Mass. 1992)).

39. *State v. Harvey*, 649 So.2d 783, 788 (La. App. 2d Cir. 1995).

40. *See id.*

41. *See id.*

42. *See id.*

therefore prejudicial.⁴³ The defense also contended that the animations were cumulative since the coroner's testimony, autopsy photographs, and autopsy report sufficiently illustrated the state's argument about how the incident occurred.⁴⁴

In affirming the trial court's admission of the evidence, the court of appeals referred to the Louisiana Supreme Court's opinion in *State v. Trahan* in which that court had found that a "video reenactment of the defendant's version of how a portion of the incident occurred was inadmissible because it was not supported by the defendant's testimony."⁴⁵ The court of appeals also referred to *State v. Video Joe, Inc.* in which diagrams were held "admissible to aid the jury in understanding testimony if they are a reasonable visual demonstration of the events which the witnesses are relating."⁴⁶ In affirming the trial court, the court of appeals in line with *Video Joe* noted that the computer presentation was an accurate depiction of the coroner's testimony.⁴⁷ The court then held that although the presentation illustrated or recreated the coroner's version of how the shooting most likely occurred, the evidence was admissible as the court construed it to be an "animation" and a "visual demonstration," thus reducing the evidentiary hurdles which the presentation might otherwise have encountered as a true simulation.⁴⁸

What can be inferred from these cases is that characterization as an animation or a simulation appears to be the key to unlocking the door to admissibility not only in Louisiana, but elsewhere. For example, in *Dorsett v. American Isuzu Motors, Inc.*, a federal court in Pennsylvania held that the admission of a videotape of a vehicle crash simulation using dummies was acceptable even though the simulation was not identical to the crash.⁴⁹ The court felt an admission that the evidence was not an exact recreation in the expert's testimony cured any confusion as to whether the computer graphic was a recreation of this incident.⁵⁰ The court then treated the simulation as an animation and, as such, purely demonstrative evidence.⁵¹ Based on this analysis the Court admitted the evidence because, as an animation it "need not be identical to the case at

43. *See id.*

44. *See id.*

45. *Id.* (quoting *State v. Trahan*, 576 So.2d 1, 7 (La. 1990)).

46. *Id.* (quoting *State v. Video Joe, Inc.*, 578 So.2d 182, 187 (La. Ct. App. 1st Cir. 1991)).

47. *Id.*

48. *Id.*

49. *Dorsett v. American Isuzu Motors, Inc.*, 805 F. Supp. 1212, 1228-29 (E.D. Pa. 1992).

50. *Id.* at 1229.

51. *Id.*

bar to be admissible; the test need only be similar enough to be helpful to the jury.”⁵²

Likewise, in *Burk v. Illinois Central Gulf Railroad Co.*, the defendant was permitted to introduce a video recreation of the accident showing a scale model of the area with surrounding foliage, stores, signs, etc.⁵³ The Defendant conceded that the video was not an accurate depiction of the plaintiff’s or the defendant’s respective views. Moreover, the defendant’s expert had admitted as much.⁵⁴ Opposing counsel had also noted these inaccuracies for the record during the expert’s testimony.⁵⁵ Despite these imperfections, and even though it was not completely accurate, the animation was admitted.⁵⁶

In summary, it appears that animations, if identified or labeled as purely demonstrative evidence rather than as a simulation, will generally be admitted. Further, it appears (at least in Louisiana) that the evidence will continue to be evaluated on a case by case basis requiring that: (1) the simulation depict in a reasonably accurate fashion what it is supposed to depict; (2) the simulation helps to establish or illustrate facts in the case; (3) the simulation aid the fact finder; and (4) the evidence not be prejudicial.⁵⁷

C. *Evidentiary Prerequisites to the Admission of Computer Generated Materials*

In the case of computer simulations, the courts appear uniform in their requirement that the computer information be tendered to opposing counsel well before trial. In *Baugh v. Gulf Air Transport., Inc.*, the trial court refused to admit the computer simulation because the plaintiff did not notify the defendant of plaintiff’s intent to use the simulation during expert testimony.⁵⁸ The disclosure requirements are a two-way street, however. For example, in *Jochims v. Isuzu Motors, Ltd.*, the court did not require the plaintiff to produce documentation concerning the validation of the computer simulation program since the defendant had delayed too long in requesting the information.⁵⁹

52. *Id.*

53. *Burk v. Illinois Cent. Gulf R.R. Co.*, 529 So.2d 515, 522 (La. Ct. App. 1st Cir. 1988).

54. *See id.* at 521-22.

55. *See id.* at 522.

56. *See id.*

57. *See Malbrough v. Wallace*, 594 So.2d 428, 431 (La. App. 1st Cir. 1991).

58. *Baugh v. Gulf Air Transp., Inc.*, 526 So.2d 1239, 1240-41, (La. Ct. App. 3d Cir. 1988).

59. *Jochims v. Isuzu Motors, Ltd.*, 145 F.R.D. 507, 511-12 (S.D. Iowa. 1992).

In *Strock v. Southern Farm Bureau Casualty Insurance Company*, the defendant sought to exclude a computer animated videotape simulation of damage to the plaintiff's beach house resulting from Hurricane Hugo.⁶⁰ The simulation was offered for the first time fifty-one days before the third trial, as the jury in the prior two trials had been unable to reach a verdict.⁶¹ The day before the third trial was to begin, a revised version of the videotape simulation was delivered to counsel for the defendant insurance company.⁶² The insurance company objected based on untimeliness, arguing that the Fourth Circuit should establish a "hard and fast rule" concerning the admissibility of computer-animated videotape simulations which would require that computer simulations "purporting to recreate events be 'substantially similar' to the actual events."⁶³ The court declined to create a rigid standard for the admissibility of computer animated videotape simulations and deferred to the trial court's judgment as to the timing and the weighing of the probative value of the evidence against its potential prejudicial effect.⁶⁴

Finally, in *Bartley v. Isuzu Motors, Ltd.*, the court outlined the scope of the opposing party's rights of discovery and access to a computer simulation which the party was attempting to introduce.⁶⁵ The plaintiff had retained an expert witness to conduct computer simulations of the vehicle involved in an automobile collision.⁶⁶ The defendant sought not only the results of the simulation model which the plaintiff hoped to introduce at trial, but also copies of each simulation or "iteration."⁶⁷ In ruling in favor of the defendant's request, the court reasoned:

When one party seeks to present a computer study, in order to defend against the conclusions that are said to flow from these efforts, the discovering party not only must be given access to the data that represents the computer's work product, but he also must see the data put into the computer, the programs used to manipulate

60. *Strock v. Southern Farm Bureau Cas. Ins. Co.*, 1993 WL 279069 at *1 (unpublished disposition), 998 F.2d 1010 (unpublished tabled decision) (4th Cir. 1993).

61. *See id.*

62. *See id.*

63. *Id.* at *2, n.3 (citing *Gladhill v. General Motors Corp.*, 743 F.2d 1049 (4th Cir. 1984); *Chase v. General Motors Corp.*, 856 F.2d 17 (4th Cir. 1988)).

64. *See id.* at *1 (citing *Reed v. Tiffin Motor Homes, Inc.*, 697 F.2d 1192, 1199 (4th Cir. 1982)).

65. *Bartley v. Isuzu Motors, Ltd.*, 151 F.R.D. 659, 660 (D. Col. 1993).

66. *See id.*

67. *See id.*

the data and produce the conclusions, and the theory or logic employed by those who planned and executed the experiment. All of the information used in generating the computer simulations is relevant to Defendants' challenge of this evidence, not merely the information which conforms to Plaintiff's theory of the case.⁶⁸

On this basis, the court held that the plaintiff and his experts would have to make and preserve an electronic and/or hardcopy record, whichever was feasible, of all simulations and iterations performed or created by the plaintiff's experts.⁶⁹

As to other noteworthy evidentiary requirements, in *Pino v. Gauthier*, the court excluded the simulation simply because the opposing party was unable to change any of the variables or produce an alternative version of the videotape for the jury to view.⁷⁰ This interactive element of the computer presentations will probably continue to be an important requirement as computer simulations advance in technique.

D. Use of Curative Instructions to Admit Computer Generated Material

Another important concept with regard to the admissibility of computer simulations and animations is the fact that courts will sometimes focus upon the importance or critical nature of the computer simulation in the overall presentation of the case and grant some leeway to the offering party. Sometimes this special dispensation takes the form of overruling an exception to the timeliness of a particular presentation.⁷¹ At other times, courts will institute curative instructions where a jury is involved.

For example, in *Robinson v. Missouri Pacific Railroad Co.*, the trial court admitted a videotape illustrating a collision between a train and a car at an intersection.⁷² Paving the way to admissibility was the court's labeling of the computer demonstration as "an animation."⁷³ On appeal, the court outlined the extensive foundation which had been set out in order to overrule objections to the admission of the computer evidence.⁷⁴

68. *Id.* at 660-61 (citations omitted).

69. *See id.* at 661.

70. *See supra* notes 10-15 and accompanying text.

71. *See, e.g., Jochims v. Isuzu Motors, Ltd.*, 144 F.R.D. 350, 351-53 (S.D. Iowa. 1992); *supra note* 59 and accompanying text.

72. 16 F.3d 1083 (10th Cir. 1994).

73. *Id.* at 1087.

74. *See id.* at 1086-88.

In this regard, the court noted that the plaintiff's expert had made a scale model of the accident scene based on the examination of the physical evidence, photographs of the wreckage, and observations made during visits to the crossing.⁷⁵ The model included a train and car which could be moved, along with crossing gates, structures, and shrubs simulating the immediate surroundings.⁷⁶ The consultant then had the video camera track the scene every 1/10 of a second as he moved the model vehicles by hand.⁷⁷ The simulation resulted in a dramatic two-minute silent color video "which depicted both the plaintiff's theory and the defendant's theory as to how the incident occurred."⁷⁸

In affirming the trial court's admission of the evidence, the court of appeals noted that the evidence was offered simply to illustrate the expert's theory.⁷⁹ The court of appeals also noted that there were certain missing or inaccurate details.⁸⁰ Nevertheless, the court distinguished the greater foundation requirements for simulations as opposed to those required for the animation at issue.⁸¹ The court of appeals stated that "experiments which purport to re-create an accident must be conducted under conditions similar to that accident, while experiments which demonstrate general principles used in forming an expert's opinion are not required to adhere strictly to the conditions of the accident."⁸² The court noted that given the "limited, solely illustrative purpose for introducing the exhibit, the cautionary instruction to the jury, and the opportunity for vigorous cross-examination, [it did] not believe the district court abused its discretion in admitting the second scenario."⁸³

In sum, it appears that the labeling of an exhibit as a mere animation—as opposed to a simulation or recreation—coupled with a curative jury instruction will lead to the admissibility of many computer simulations. This appears to be the general trend in the courts at this time.⁸⁴

75. *See id.* at 1086.

76. *See id.*

77. *See id.*

78. *See id.*

79. *Id.*

80. *Id.*

81. *Id.* at 1087 (citing *Gilbert v. Cosco, Inc.*, 989 F.2d 399, 402 (10th Cir. 1993)).

82. *Id.* (quoting *Gilbert v. Cosco, Inc.*, 989 F.2d 399, 402 (10th Cir. 1993)).

83. *Id.* at 1088.

84. *See, e.g., Datskow v. Teledyne Continental Motors*, 826 F. Supp. 677, 685-86 (W.D.N.Y. 1993).

E. *The Effect of Daubert on the Admission of Computer Generated Materials*

No discussion related to admissibility of computer evidence would be complete without some reference to the four factors of the United States Supreme Court's recent decision in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*,⁸⁵ which has now been applied in Louisiana.⁸⁶ The four admissibility factors stemming from the Supreme Court's analysis of Federal Rule of Evidence 702 are (1) whether the scientifically valid reasoning or methodology can be and has been tested; (2) whether the particular reasoning or methodology has survived peer review or has been published; (3) whether the reasoning, methodology or scientific techniques have been developed to the point whether the error rate and appropriate standards are known; and (4) whether the reasoning, methodology or techniques are generally accepted in the scientific community or the evidence is based on well-established scientific principles.⁸⁷

A *Daubert* challenge is a separate inquiry aside from whether a proper foundation has been established. In other words, as a threshold test of admissibility, the party offering a computer simulation even as demonstrative evidence must establish that it is a fair and accurate representation of the scene sought to be depicted, without which foundation the evidence cannot be admitted.⁸⁸

A *Daubert* challenge presents a second level of scrutiny, which is well illustrated in *Livingston v. Isuzu Motors, Ltd.*⁸⁹ In that case, which stemmed from a single-vehicle, off-road rollover accident, the plaintiffs were permitted to introduce a computer simulation and accident reconstruction in conjunction with the testimony of one of their experts.⁹⁰ The defendants contended that "the simulations were neither scientific nor reliable."⁹¹ The court admitted the evidence, based on a review of the four *Daubert* factors.⁹²

85. *Daubert v. Merrell Dow Pharm., Inc.*, 113 S. Ct. 2786 (1993).

86. *See, e.g.*, *State v. Foret*, 628 So.2d 1116, 1123 (La. 1993).

87. *See* Bonnie J. Davis, Comment, *Admissibility of Expert Testimony After Daubert and Foret: A Wider Gate, A More Vigilant Gatekeeper*, 54 LA. L. REV. 1307, 1316-17 (1994).

88. *See, e.g.*, *Cornell v. State*, 463 S.E.2d 702, 703 (Ga. 1995) (Defendant failed to establish adequate foundation for admission of computer reenactment of fatal shooting.)

89. 910 F. Supp. 1473, 1495 (D. Mont. 1995).

90. *See id.*

91. *Id.* at 1494.

92. *See id.* at 1495.

As to the first factor, whether the theory had been tested, the court held that “[t]he complexity of the mingling of this information precludes testing beyond verification of the data involved.”⁹³ Noting that since “exact reenactment of the accident would not be practical or prudent,” the court concluded that “to the extent it can be . . . the theory behind the computer simulation has been tested.”⁹⁴

The court next concluded that the computer simulation had passed the second *Daubert* factor (peer review) since in the expert’s testimony regarding the computer simulation methodology, the expert referred to “several lectures made on the subject and presentations to members of the scientific community, including automobile manufacturers and engineers.”⁹⁵ As to the third *Daubert* factor (the known or potential rate of error) the court noted that it is “again, difficult to gage [sic] given the complexity of the computer simulation.”⁹⁶ The court felt that this requirement had been met by giving the defendants ample opportunity to cross-examine the witness.⁹⁷ Finally, as to the fourth factor (general acceptance in the scientific community) the court held that this requirement had been met through the testimony of the expert who had “identified peers within his discipline who have worked with him and evaluated his work.”⁹⁸ Having decided that the evidence met the four *Daubert* requirements, the court admitted the evidence.⁹⁹

III. OF GIS AND PLUMES

The third type of computer evidence, GIS tracking data, rarely runs into problems related to admissibility. This is because the data consists of an accumulation of governmental data bases.¹⁰⁰ Each electronic data point contained in the computer is itself a business or public “record” or a “data compilation, in any form,” such that it should satisfy the hearsay exceptions set forth in Rules 803(6) and 803(8) of the Federal Rules of Evidence related to business records and public records as well as the correlative rules under the Louisiana Code of Evidence.¹⁰¹ At the same time, since GIS is not scientific evidence but rather a form of

93. *Id.*

94. *Id.* at 1495.

95. *Id.* at 1495.

96. *Id.*

97. *Id.*

98. *Id.*

99. *See id.*

100. Gregory P. Joseph, *Computer Evidence*, 22 LITIGATION, 14 (Fall 1995).

101. *Id.*

map, “the test for its admissibility should be whether it accurately represents what it purports to represent.”¹⁰² Finally, another basis for admissibility is the “silent witness” exception to hearsay set forth in Federal Rule of Evidence 901(b)(9) which relates to devices that accurately record events when they occur.¹⁰³ This is because the GIS databases are often merged with satellite images or aerial photographs which accurately depict ambient conditions or land masses at a particular point in time.

As to exactly what GIS databases are, these have been defined as follows:

In its simplest form, a GIS is a computer software program which performs various calculations and functions using compilations of physical, geographic, or demographic data. A GIS is ‘designed for the collection, storage and analysis of objects and phenomena where geographic location is an important characteristic or critical to the analysis.’ Typically, a GIS produces maps and tables generated by complex mathematical methods designed to satisfy criteria that users have specified. An example is a graphical depiction of properties which meet certain size, zoning, and price characteristics (e.g., lowest priced residential acreage). Local governments use many types of GIS which are capable of generating maps and charts based on land survey data. One of the fastest growing GIS applications ‘integrate(s) property rights information with information on the uses, values and distribution of natural and cultural resources.’ The maintenance of official records of interests in property, termed cadastres, increasingly use GIS technology. Related to GIS technology are global positioning systems (GPS) used on trucks, boats, cars, and trains for navigational and commercial purposes as well as ‘virtual reality’ systems which take users into three-dimensional worlds.¹⁰⁴

102. Commonwealth Dept. of Envtl. Resources v. Al Hamilton Contracting Co., 665 A.2d 849, 852 (Pa. Commw. Ct. 1995).

103. See Mario Borelli, *The Computer as Advocate: An Approach to Computer Generated Displays in the Courtroom*, 71 IND. L.J. 439, 446 (1996).

104. Scott D. Makar & Michael R. Makar, Jr., *Geographic Information Systems: Legal and Policy Implications*, FLA B.J., Nov. 1995, at 44 (quoting Stan Aronoff, GEOGRAPHIC INFORMATION SYSTEMS: A MANAGEMENT PERSPECTIVE 1, 41 (1993)).

For courtroom purposes, if this type of information is superimposed on a backdrop of an aerial photograph or satellite image, both of which are readily available from the federal government, the display gives an extremely convincing presentation of a particular location. Furthermore, if the location of persons, substances, structures, or property lines are further corroborated by hand-held Global Positioning System (GPS) “fixes” or the location of known geographical landmarks, the presentation gives a more-or-less irrefutable foundation or backdrop for the location of points of interest that are relevant to the offering party’s case.

For example, in *Pennsylvania Electric Co. v. Waltman*, GIS information was presented in a property dispute.¹⁰⁵ In that case a defendant property owner had built structures on property he believed to be his.¹⁰⁶ The power company believed that these structures had been built on its property because the land was allegedly part of a tract which had been allocated to a dam-construction project.¹⁰⁷ In support of his defense, the property owner had submitted various surveys and computer simulations in an effort to show that the improvements or structures did not encroach upon the power company’s property.¹⁰⁸ The court concluded that these simulations made it possible to calculate with mathematical certainty where the property as set forth in the county realty deed was located.¹⁰⁹ Further, the court accepted the testimony of the defendant’s expert to the effect that the “modern computer simulation could establish the acreage of a tract within an inch.”¹¹⁰ This holding demonstrates the dramatic power of this type of evidence, since it is all but dispositive of any issues related to location. This is largely because it is based on governmental documents or information.

We have found that when GIS information has been used as a backdrop and the colorized results of a computer “plume model” depicting a release of a substance are superimposed upon the GIS data, an intriguing and dramatic presentation is created. In class actions (or cases involving multiple plaintiffs from a single geographical area) related to exposure to a substance, this presentation is further enhanced when an aerial photograph or satellite image is merged with the GIS data so that the plume of the substance at issue can be seen in relation to the location

105. *Pennsylvania Elec. Co. v. Waltman*, 670 A.2d 165, 1169 (Pa. Super. Ct. 1995).

106. *See id.* at 1167.

107. *See id.*

108. *See id.* at 1168.

109. *See id.*

110. *Id.* at 1169.

of the local populace. The effectiveness of these presentations is largely dependent upon the accuracy and persuasiveness of a computer model.

IV. RELEASE MODELING

In order to make effective courtroom use of the merger of GIS, release modeling and aerial photography, it is important to understand the role it plays in an effective presentation of computer generated materials. In particular, it is important to understand the nuances of release modeling which might lead to inaccuracies in the presentation. What follows is a discussion of dispersion modeling for the release of air contaminants.

Accidental releases of air contaminants from a facility occur in many forms. They may be caused by ruptured storage vessels, broken safety valves, process errors, and upset conditions. When these releases occur, it is frequently necessary to estimate the potential downwind exposure of employees or the public to the substance at issue. The estimated exposure, as calculated by computer air dispersion models, is normally expressed in terms of concentration with units of micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) or parts per million (ppm). The predicted concentrations can then be used by a qualified toxicologist to estimate the incidence of odor or resulting risk levels for those exposed.¹¹¹

Dispersion modeling is considered to be both an art and a science. There are numerous variables to consider in any such analysis, each of which may be open to careful scrutiny and analysis during the litigation process. The method of application of the data is as important to the modeling process as the integrity of the data being used. As such, it is critical that before one embarks on any such analysis that they be well-versed in the principles and practice of air dispersion modeling.

Once a substance is released into the atmosphere, downwind dispersion of it is largely driven by meteorological considerations. In reality, dispersion of the material takes place on both a very small (micro)

111. For a more comprehensive inquiry into air dispersion release modeling, *see generally* S.R. Hanna et al., *Hazardous Gas Model Evaluations With Field Observations*, 27A *ATMOSPHERIC ENVT.* 2265 (1993) (discussing the relative accuracy of fifteen hazardous gas models, including INPUFF, SLAB, and DEGADIS, based upon field tests of each method); Thomas J Sullivan et al., *Atmospheric Release Advisory Capability: Real-Time Modeling of Airborne Hazardous Materials*, 74(12) *BULL. OF THE AMERICAN METEOROLOGICAL SOC.* 2343 (1993) (assessing the capabilities of the Atmospheric Release Advisory Capability (ARAC) method of release modeling); Leif R. Griffin & Thomas L. Rutherford, *Comparison of Air Dispersion Modeling Results With Ambient Air Sampling Data: A Case Study at Tacoma Landfill, A National Priorities List Site*, 13(3) *ENVT'L PROGRESS* 155 (1994) (comparing predicted and actual releases).

scale and on a larger (macro) scale. On the microscale, small areas of turbulence, referred to as eddies, are generated by nearby structures (trees, buildings, etc.), thermals, and split-second variations in wind speed and direction. These eddies tend to disperse the plume upon release, entraining ambient air into the released cloud. These microscale effects may also play a considerable role farther downwind from the release point where the material becomes entrapped in eddies around buildings (causing a momentary, instantaneous high concentration) or in forest canopies and other stagnant areas. Motion of the material may be disrupted or altered by small variations in terrain or when man-made objects such as levees are encountered. Microscale effects are extremely difficult to describe mathematically. The variables involved are only reproducible in carefully designed laboratory settings. Therefore, most small-scale effects, no matter how logical and critical, can only be incorporated qualitatively.

A majority of air dispersion models predict downwind concentrations using mathematical algorithms that describe macroscale effects. Wind speed, wind direction, ambient temperature, and stability are the most-common inputs to these simplified Gaussian models. Wind speed drives the rate of transport, degree of shearing, and instantaneous concentrations. Wind direction determines which geographical areas are exposed; ambient temperature influences the rise of the material above the ground; stability dictates the level of mixing of the material with the ambient air. Data for each of these variables are readily available from government sources.

In addition to meteorological data, the modeler must be able to define the characteristics of a release. A ruptured tank has significantly different modeling implications than a broken safety valve. A jet release purge valve will be modeled differently than a controlled flow stack. Depending on the character of the release, the modeler must choose which model to use and what variables must be collected. Examples of necessary source data include the height of the release above ground level, temperature of the stack gas, rate of release, volume of release, diameter of discharge point, physical characteristics of the released material (molecular weight, density curves, heat capacity, boiling point, etc.), initial volumetric concentration at the release point, physical orientation of the release point, and the phase of the release.

Using the data listed above, the modeler must determine whether the material will exhibit dense or neutral gas characteristics. A dense gas is defined as one where the potential energy of the cloud resulting from

the release is greater than the turbulent energy in the atmosphere. This results in slumping of the material on the ground, where it then resides in a shallow pool that mixes with ambient air as it is pushed downwind. An example of a dense-gas release is the rupture of a chlorine tank, where the release may be characterized as multi-phase consisting of a flash vapor component, aerosol drops, and a liquid pool. On the other hand, an example of a neutral release is the emission of nitrogen oxides or carbon monoxide from an internal combustion source (boiler, furnace, etc.).

Model selection may also be dictated by the type of standard or threshold to which the modeler or toxicologist will be making a comparison. Chronic effects require that a model be able to estimate annual concentrations. Acute effects normally require a concentration with an averaging period of one hour or less. Odor or flammability thresholds involve an even shorter time scale, sometimes instantaneous. Different models accommodate different averaging periods.

Other considerations in a modeling analysis include building downwash and terrain effects. Nearby buildings or other structures tend to form local eddies that entrain the released plume, decreasing the plume's height. This can increase near ground-level concentrations dramatically (by more than 60%). High terrain near a source can also increase concentrations as the plume impacts the side of the hill. Special models and preprocessors exist for each of these common special cases.

INPUFF and SCREEN3 are common neutral-gas models used in estimating impacts from accidental releases. The INPUFF model can use on-site, short-term meteorological data to estimate downwind concentrations and plume meandering. Most EPA Gaussian models use only hourly meteorological data and are unable to account for changes in wind direction on a shorter time scale. Such variations can be important in litigation. SCREEN3 uses EPA worst-case meteorological conditions to estimate the worst-case maximum concentration at a series of downwind receptors. Hourly meteorological data is assumed and the plume is assumed to travel directly to a series of receptors placed immediately downwind of the release. INPUFF allows the user to specify receptors at discrete geographical points (schools, residences, etc.) and will accommodate averaging periods of less than or more than one hour. SCREEN3 only allows the input of downwind distances and predicts one-hour concentrations (which can be extrapolated upward using EPA-approved factors).

Dense gas models generally require more-specialized data than the neutral gas models. Both SLAB and DEGADIS are used for the

modeling of accidental releases. SLAB allows the user to represent evaporating pools, horizontal releases, and vertical releases. DEGADIS accommodates vertical releases, and evaporating pools, and it also allows for a time-dependent emission release. Both models require that the user carefully characterize the source. Minor adjustments in variables may result in large changes in predicted concentrations. Meteorological inputs are generally simple, consisting of temperature, wind speed and direction, stability, humidity, and mixing height. If actual meteorological data for the incident is not available, the modeler should employ U.S. EPA worst-case parameters. For both models, averaging periods on the order of less than one hour can be specified.

V. USE OF MODELING IN LITIGATION

In *Anderson v. Marathon Oil Co.*, the court held, *inter alia*, that punitive damages were not available under Louisiana Civil Code Article 2315.3 which allowed such damages against defendants dealing with hazardous or toxic substances.¹¹² The basis for the court's ruling was that a computer plume model showing a "footprint" of the path of an accidental release of ethyl mercaptan showed that the concentrations of the mercaptan were not above the hazardous or toxic threshold when the substance reached the nearest residential community.¹¹³

Similarly, in *Rivera v. United Gas Pipeline Co.*, residents of a neighborhood evacuated as a result of a natural gas leak had filed a class action against the owner of the pipeline involved as well as against a contractor who was working on the pipeline at the time of the incident.¹¹⁴ As part of the defense, the defendants presented a computerized plume showing the extent of the natural-gas leak and the limited exposure, if any, to the residents of the community.¹¹⁵ This plume was superimposed on a backdrop of a color U2 photograph of the area which was, in turn, integrated with a GIS data base.¹¹⁶ This allowed for both the parameters of the plume of natural gas as well as the residents of the neighborhood to be located with considerable accuracy.¹¹⁷ Further, the plume suggested that few if any of the residents of the community were exposed to any

112. *Anderson v. Marathon Oil Co.*, 1994 W.L. 396193 *2 (E.D. La. 1994).

113. *See id.*

114. *Rivera v. United Gas Pipeline Co.*, C.A. No. 23908 "Div. C" (40th J.D.C., Parish of St. John the Baptist, State of Louisiana (June 7, 1995)).

115. *See id.*

116. *See id.*

117. *See id.*

dangerous levels of natural gas.¹¹⁸ As a result, the plaintiffs' last settlement offer prior to a trial of twenty-four bellwether plaintiffs was \$26 million.¹¹⁹ The jury returned a verdict of \$7,500.00 as the collective award for all twenty-four "bellwether" plaintiffs.¹²⁰ The jury also found that the plaintiffs were not entitled to punitive damages.¹²¹

Finally, in *Adams, et al. v. Marathon Oil Co.*, the court used a plume footprint to decide the parameters of the class of claimants who would be entitled to proceed in a class action.¹²² In other words, those individuals who were located outside of the plume as shown in the GIS tracking graphic offered by the defendant were excluded from the class. This method of establishing a class (*i.e.*, utilizing air disbursement modeling) is a recognized method for establishing the geographic class parameter in class actions.¹²³

Evidence along these lines has recently been admitted into the record of another class action related to oyster lease damages.¹²⁴ In *Avenal v. State of Louisiana, Department Of Natural Resources*, the plaintiffs alleged that their oyster leases were damaged by the freshwater outfall from the Caernarvon freshwater diversion structure located on the lower Mississippi River in Plaquemines Parish.¹²⁵ Although the court certified a class of all plaintiffs in the Breton Sound area, the court concluded that many plaintiffs' leases within the class, as certified, had not been damaged by the freshwater outfall.¹²⁶ The court's conclusions were based on GIS tracking data related to the Breton Sound area in lower St. Bernard and Plaquemines Parishes, as presented by the defendant, the state of Louisiana.¹²⁷

VI. PLUMES AND PITFALLS

Plume evidence is not always admitted. For instance, in *In re TMI Litigation Cases Consolidated II*, the court excluded certain plume

118. *See id.*

119. *See id.*

120. *See id.*

121. *See id.*

122. *Adams v. Marathon Oil Co.*, C.A. No. 29843 "Div. C", (40th J.D.C., Parish of St. John the Baptist, State of Louisiana (Mar. 22, 1995)).

123. *See, e.g., Livingston Parish Police Jury v. Acadian Shipyards*, 598 So.2d 1177, 1184 (La. App. 1st Cir. 1992).

124. *Avenal v. State of Louisiana, Dept. of Natural Resources*, C.A. No. 38-266 "Div. B" (25th J.D.C., Parish of Plaquemines, State of Louisiana (Feb. 6, 1996)).

125. *See id.*

126. *See id.*

127. *See id.*

model evidence which was purportedly supportive of the plaintiffs' theory regarding the dose of radiation emitted from the Three Mile Island (TMI) nuclear reactor incident on March 28, 1979.¹²⁸ The court applied a Federal Rule of Evidence 702 analysis under *Daubert* to exclude evidence of an expert's "plume movie and water model."¹²⁹ The basis for the court's decision was "an absence of 'fit.'"¹³⁰ The court noted that the plume movie and water model were not accurate depictions of plume dispersion during the incident and were being offered merely to demonstrate "what may have happened."¹³¹ The court stated the basis for the exclusion of the evidence as follows:

The plume movie does not "fit" within the case because it is based upon an undefined source term, fails to account for weather readings on the TMI weather tower, and fails to incorporate all primary data. Thus, it cannot be found to bear a valid relationship to the TMI accident. Similarly, the water model does not take into account the actual topography of the TMI area. Any demonstration performed using the water model, therefore, would not bear a close relationship to the way a substance would be disbursed into the atmosphere around TMI. . . . Neither the plume movie nor the water model speak clearly to any issue in dispute in this case. Because neither purports to provide an accurate representation of plume dispersion during the accident, the models cannot "clearly" speak to anything.¹³²

An additional reason for the exclusion was the court's belief that it would confuse the trier of fact.¹³³ The court referred to *Fusco v. General Motors Corp.*, in which an accident replication videotape had been excluded because the "drama of the videotape was capable of overcoming the logic of the distinctions raised by opposing experts."¹³⁴ In any event, the court in *TMI* did allow the expert to testify to a limited degree but without his models.¹³⁵ This case reestablishes the importance

128. *In re TMI Litigation Cases Consolidated II*, 911 F. Supp. 775, 779 (M.D. Pa. 1996).

129. *Id.* at 798.

130. *Id.*

131. *Id.*

132. *Id.*

133. *Id.* at 798-99

134. *Id.* at 799 (citing *Fusco v. General Motors Corp.*, 11 F.3d. 259, 263-64 (1st Cir. 1993)).

135. *Id.*

of an element of “actual reality” in any computer graphics presentation. Mere “virtual reality” will not carry the day.

VII. CONCLUSION

The precedents and authorities set forth above suggest a trend toward more accuracy and realism in the presentation of computer graphics. If a party chooses to move in the other direction, the party will, in all probability, have its evidence limited to demonstrative use only. It is submitted that the utilization of GIS tracking with computer graphics in the courtroom, where possible, will greatly increase the likelihood of admissibility as well as a successful outcome on the merits. By necessity, the art, craft, and jurisprudence associated with computer graphics will continue to evolve with a resulting clearer test for admissibility. Undeniably, the trier of fact will be the beneficiary.