Science and Engineering Ethics (2004) ***10****, 655-666*

The Ethics of Earthquake Prediction

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Keywords: earthquake prediction, ethics, responsibility, freedom, consequentialism, rights view

Abstract: *Scientists' responsibility to inform the public about their results may conflict with their responsibility not to cause social disturbance by the communication of these results. A study of the well-known Brady-Spence and Iben Browning earthquake predictions illustrates this conflict in the publication of scientifically unwarranted predictions. Furthermore, a public policy that considers public sensitivity caused by such publications as an opportunity to promote public awareness is ethically problematic from (i) a refined consequentialist point of view that any means cannot be justified by any ends, and (ii) a rights view according to which individuals should never be treated as a mere means to ends. The Parkfield experiment, the so-called paradigm case of cooperation between natural and social scientists and the political authorities in hazard management and risk communication, is also open to similar ethical criticism. For the people in the Parkfield area were not informed that the whole experiment was based on a contested seismological paradigm.*

Introduction

Communicating results of scientific research to the public may sometimes create a tension between scientists' responsibility to inform the public about their results and their responsibility not to cause social disturbance by the communication of these results. This tension is seen in earthquake prediction research (EPR), for earth scientists, in particular seismologists, must be under greater ethical pressure than other scientists, as their words on prediction affect society as a whole. It seems then possible to argue that it is the scientist's public responsibility to inform people about her work, and in turn, it is the people's right to know about scientific research activities. The ultimate ground of justification of such liberalism is that open society is favourable both to scientific progress and to public well-being. On the other hand, one may argue

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Paper received, 3 September 2003: accepted, 5 December 2003.

that communication of scientific results to the public must be restricted in some cases. This view rests on the idea that avoiding social disturbance is much more important than the public's alleged right to hear all scientific opinions, including every unwarranted hypothesis and prediction. The publication of unwarranted scientific predictions and/or guesses in general may lead to an increase in public sensitivity. Scientists and public officials may see this situation as an occasion to gain public benefit. But such a public policy is ethically problematic, since it may be seen as liable to violate people's right not to be treated as mere means to an end whatever those public benefits may be.

We hope to gain insight into problems concerning communication of scientific results to the public at large by examining three well-known cases of EPR, namely the Brady-Spence and Iben Browning predictions and the Parkfield experiment.

Problems in Communicating Unwarranted Hypotheses to the Public

The liberal position on EPR is manifested by the views of Clarence R. Allen, who later became chairman of the National Earthquake Prediction Evaluation Council (NEPEC).[1] Allen claims that keeping information, however crude, from the public and discussing hypotheses on earthquake prediction "behind closed doors" would cause more harm than good, for free speech is the only means to promote research and to increase public responsibility of scientists.[1] Allen also expects that the public's demand for accurate information would encourage scientists to further their research and hinder them from making unwarranted statements that may cause disturbance in society.[1] Allen seems to suggest that free scientific communication in its due course would bring order to the scientific environment by eliminating unwarranted scientific hypotheses and predictions, together with the guesses of amateurs and cranks. Michael Dummett's views are similar to Allen's regarding scientists' freedom to distribute their results within the scientific community.[2] Dummett says that in science we may expect that "the truth shall prevail in the long term. It does not matter greatly, in science, if the majority is mistaken, and continue in their error for a considerable time, so long as the correct view eventually triumphs."[2 (pp.281-2)] Dummett's understanding of freedom is different when it comes to communication of scientific results to the public at large, because then science becomes a social and political affair. Dummett says that here "the question is not at all one of eventually arriving at the truth: in these spheres, false beliefs lead to harmful actions, by individuals, by governments or by institutions within the State."[2 (p.282)]

It is a deeply entrenched belief that scientific progress requires freedom of communication within the scientific community. But this freedom, of course, does not mean that every unwarranted view may be published. In order to get published in respectable scientific journals, scientists have to go through peer review processes that filter out unwarranted hypotheses and results. Mass media throughout the world at present, however, seem to have a relatively less qualified review procedure, if any. Hence someone who is not convinced by these liberal arguments may expect benefits from restricting scientists in communicating unwarranted hypotheses and predictions to

the public by introducing ethical codes. This opponent would maintain that avoiding social disturbance must be much more important than the public's alleged right to hear such hypotheses and predictions. From this point of view, professional ethical codes may be necessary to discourage scientists from addressing themselves directly to the public before going through critical review. Such ethical codes would, however, apply only to professionals. Those who are not members of professional organizations would not feel constrained by such restrictions. These people could, therefore, continue to publicize their speculations whenever and wherever they find the opportunity. Given the mass media's interest in sensational news and the opportunities of the Internet, there may be no end to the dissemination of wild hypotheses and guesses by pseudoscientists and cranks. Should one then expect scientists to compete with these people through rhetorical rather than scientific means? There is no guarantee that cranks may not be more influential and find wider coverage than scientists. Although one must be very cautious not to violate freedom of speech, it must nevertheless be realized that laymen, who may not fully appreciate scientific matters, must not be expected to settle such disputes. Hence mass media could hardly be considered as a public forum where hypotheses are to be evaluated by non-experts.

No doubt, one must here also take into consideration issues regarding media ethics. In certain cases, scientists may hardly foresee how their statements will appear in mass media. It is not impossible to imagine that in the media representation, certain parts of the scientists' statements be removed out of their context and/or certain details be exaggerated. Of course, this would lead to essential distortions. But this does not remove the ethical responsibility of scientists to be discreet when they are communicating their views to the media. In this paper we are primarily concerned with ethical problems related to scientists' communication of their hypotheses. A full survey of the ethical issues concerning science communication does require a thorough analysis of questions concerning media ethics, but this falls beyond the scope of the present paper in which we try to emphasize problems concerning science ethics.

Some people even may seek benefit from the publicizing of scientifically unsupported or even wild hypotheses and predictions. Certain scientists and/or public officials may see such situations of high public sensitivity that result from the publication of unwarranted scientific predictions and/or guesses as an opportunity to increase people's hazard awareness. These people may try to justify their position by an appeal to a consequentialist argument that a good end justifies the means. This consequentialism, however, is a most crude one, if it means that any end which could be seen in itself as good would justify any means. A reasonable consequentialism, however, must satisfy at least two requirements: first, the expected goodness of an end has to balance the badness of the means; and secondly, not only the means and ends, but also side effects and further consequences have to be taken into account. Similar ethical problems may emerge even in controlled cases (e.g. the Parkfield experiment) where public policies are based on unwarranted hypotheses.

Furthermore, this attitude is totally at odds with a deontological point of view which follows from the well-known Kantian principle: "Act so that you treat humanity, whether in your own person or in that of another, always as an end and never as a

means only."[3 (p.47)] Treating people simply as means is denying their autonomy. This seems to be what many have done in the communication of earthquake predictions we will examine.

We will now discuss these ethical issues by examining the Brady-Spence and the Iben Browning predictions and the Parkfield experiment.

The Brady-Spence Prediction

Dr. Brian T. Brady, a research physicist in the Denver centre of the United States Bureau of Mines (USBM), predicted in 1976 that a series of major earthquakes from June to September 1981 would take place off the coast of Peru. Brady had developed his theory of earthquakes on the basis of his earlier work on rockburst in mines. Brady tested his theory retrospectively on several cases, two of which are the 1974 earthquakes near Lima, Peru.[4 (p.809);5 (p.10)] Dr. William Spence, a United States Geological Survey (USGS) geophysicist at the time, provided the data and also defended the prediction until June 1981. The Peruvian scientists were informed about the prediction in late 1976 when Spence sent a reprint of Brady's article to Peruvian scientists.[5 (p.11)]

The prediction leaked to the Peruvian media after Alberto Giesecke, the director of Instituto Geofísico del Peru (IGP), gave a briefing to several government agencies on November 9, 1979.[5 (p.32)] As a result, Peruvian and US officials and scientists became concerned about the reaction of the Peruvian society when some pieces of information regarding the prediction began to appear in the Peruvian media.[5 (pp.33-7)] Giesecke, for instance, feared that if some information about the prediction had fallen into the hands of the media members, it could be used politically to create panic and unrest. At the same time, however, Giesecke seems to have been ready to use this information to motivate the government officials to provide funds for IGP.[5 (p.39)] Perhaps the best policy of the public and scientific authorities, after the initial news of the prediction appeared in the media, would have been to inform the public about the prediction and its scientific status. However, the public officials, including Giesecke, preferred to remain silent in order not to cause public unrest.

In early 1980, the political situation in Peru was unstable because the country was preparing for a free election after twelve years of a military rule. Hence the silence of the officials was interpreted by the media to be a manoeuvre by the military government. It seems that they feared the government might take the prediction as an opportunity to remain in power longer.[5 (pp.35,46,142)] The prediction issue remained a rumour in the Peruvian media, because of the lack of scientific information, and it was not a top story until Allen's disclosure of the prediction to the US media in late 1980. Immediately afterward, Brady and Spence began giving interviews to the US media about the prediction.[5 (p.68)] This world-wide media attention increased Peruvians' sensitivity about the "coming" devastating earthquakes.[5 (pp.74-5)]

The impact of the prediction on Peruvian society was not limited to this media crisis. Since the Peruvian economy was already undergoing a deep recession, the mismanagement of the publicizing of the prediction threatened the Peruvian economy

by reducing property values, tourism income and foreign investment in Peru.[5(pp.43,74-5,142,151); 6(pp.127-9)] Officials and scientists reported disturbances in Peruvian society.[5(pp.74-5,141-2,149-51); 6(pp.125-6)] For example, Dr. John Filson, chief of the Office of Earthquake Prediction of the U.S. Geological Survey at the time, who was in Peru between June 25 and 29, 1981, stated the following in his report: "I had no idea of the level of anxiety and concern these predictions had caused in Lima. During my stay, every newspaper contained at least one front page story about Brady; property values have fallen drastically in Lima; many who could afford it left town for the weekend"[5 (p.151)] Olson and Olson later noted on the basis of their interviews, others' surveys, and media accounts that "although reaction [of the Peruvian people] was *behaviorally* modest, the *psychological* anxiety attendant to the prediction was pronounced."[6 (p.130)] The Peruvian government officials tried to decrease public tension by reducing the civil defence emergency simulations.[5 (pp.45,131)] The Peruvian Red Cross requested help from the United Nations, and the UN Disaster Relief Co-ordinator sent a representative to Lima. The president of Peru sought help from the USGS that convened NEPEC to review the prediction. NEPEC refused to endorse the Brady-Spence prediction because of the lack of supporting data and the speculative nature of the prediction.[5 (p.808)] Despite the NEPEC statement, however, anxiety continued to mount in Peru.[7 (p.527); 5 (p.132)] Olson *et al*. state that the involvement of USGS, NEPEC and the UN shows very clearly that the management of the prediction became a national security issue in Peru.[5 (p.66)]

Let us now try to analyse ethical problems concerning the conduct of some of the institutions and individuals involved in the Peruvian prediction affair. The Brady-Spence prediction, which rested on an untested scientific hypothesis, was discussed in scientific circles, though not very extensively. Giesecke's informing the Peruvian government about the prediction at the end of 1979 may be deemed justified, given that Peru is an earthquake prone country with a history of destructive earthquakes and given that this prediction signalled a great danger. However, the silence of the public and scientific authorities, including Giesecke, following the leak of the news to the media cannot be justified by a concern not to cause public disturbance. For, as the public was left uninformed about the scientific status of the prediction, people became vulnerable to political, economical and even religious manipulation.[5 (pp.43,74-5,142,151); 8 (p.36)] This silence seems to be a violation of people's right to be (accurately) informed about scientific matters by public authorities, and this becomes most manifest in an issue of immediate public concern. It appears that the authorities involved, therefore, did not satisfactorily perform their duty to inform the public about the scientific status, in fact the unreliability, of the prediction.

Allen, though he may have thought that the prediction had already been publicized in Peru, can hardly be considered careful of the possible harmful consequences of his talk with the US media. Although Allen was actually critical of the scientific validity of the prediction, his talk triggered worldwide publicity of the issue. A chairman of an institution like NEPEC is normally expected to estimate the effects of such announcements on the public. In defence of Allen, one might argue that he fulfilled his duty to inform the public about the unreliability of the prediction on many occasions. However, it seems optimistic to assume that the content of such talks would not be

exaggerated, for mass media throughout the world have no procedure to filter out unwarranted information. Upon Allen's talk, Brady and Spence felt free to give interviews, which seems to have contributed to the confusion. As a result, Peruvian people, who were not properly informed, were left in an atmosphere in which many conflicting scientific views that they could not fully appreciate continued to appear in the media. Allen later admitted that the scientific community and scientific institutions, such as NEPEC, USGS, USBM, may not have served the Peruvian population well and may not have promoted scientific freedom without neglecting their scientific responsibility.[9 (p.S334)]

Brady himself, of course, cannot be deemed to have been very cautious. Indeed, it would be very difficult to hold that he was quite sensitive of his professional responsibilities. As NEPEC members claimed, "Brady did not follow the usual procedure for disseminating his results."[4 (p.809)] He was invited to go through peer review processes and publish his results in scientific journals. Indeed Brady had not published anything on his prediction after his four earlier (1974, 1975 and 1976) "outdated" theoretical papers.[4 (p.809)] He, however, did not submit any work to journals. Brady announced repeatedly that he would withdraw his prediction if certain necessary precursors prior to the major events did not occur. However, each time the predicted precursors failed to appear, Brady, instead of withdrawing his prediction, chose to rationalize these failures by *ad hoc* explanations.

Another ethical question that can be raised concerns the attitude of some scientists and public officials who seem to have tried to take advantage of the publicizing of this unwarranted prediction in order to gain institutional benefits. For instance, on the Peruvian side, Giesecke did not mind using this prediction as an opportunity to motivate government officials to provide funds for IGP. Similarly on the U.S. side, the Office of U.S. Foreign Disasters Assistance (OFDA), whose mission is to promote hazard mitigation and disaster preparedness worldwide, and especially Paul Krumpe, science advisor to OFDA, considered the prediction to be a "mission opportunity" despite serious scientific objections to the prediction. For instance, Filson pointed out that, "for 2 years the USGS had emphasized to OFDA that Brady's predictions totally lacked support in the scientific community, outside of Spence's feasibility arguments."[7 (p.527)] Allen also criticized the involvement of OFDA and Krumpe in the Peruvian crisis: "is it really appropriate for the Agency for International Development, with its very limited scientific expertise, to be involved in such a scenario, particularly when it is the people of a foreign country who are the innocent 'guinea pigs' involved?"[5 (p.155)] Although both Giesecke and Krumpe acted to promote public benefit, they seem to have violated the people's right not to be mistreated by taking a scientifically unsupported prediction as an opportunity to gain such benefits. From a deontological perspective, this seems to be a violation of the people's right not to be treated as a mere means to an end.

The Iben Browning Case

The Brady-Spence prediction is instructive of the effects of a scientific prediction by scientists with good credentials. Let us now examine the Iben Browning case. Browning was not an expert on earthquake prediction, but was nevertheless ambitious to get his unwarranted predictions publicized. Scientists and scientific institutions like NEPEC were unfortunately slow to react to Browning's "prophecy" that found wide media coverage. Certain public officials wanted to take advantage of this publicity to increase public awareness of earthquake preparedness.

Iben Browning, who had M.A. and Ph.D. degrees in zoology, was working as a climatological and business consultant to some firms and organizations for several years when his 1990 New Madrid earthquake prediction was publicized through the mass media.[10 (pp.3-4)] Browning's prediction, as reported by the New Madrid Working Group of NEPEC, was that "there is a 50 percent probability that a tidally triggered, magnitude 6.5 to 7.5 earthquake will occur in the New Madrid region of the Central United States on December 2-3, 1990, plus or minus 2 days (December 1-5, 1990)."[10(p.46)] Although New Madrid was located in a stable continental interior there had been three major earthquakes (M = 8.1-8.3) in a two-month period from December 16, 1811 to February 7, 1812.[10 (p.5)] The widely accepted hypothesis that there existed a failed rift in this region made an earthquake of magnitude 6.5-7.5 conceivable. Seismologists, however, did not take Browning's prediction seriously because there were no physical models for the region.[10 (p.9)]

Other reactions to Browning's prediction varied from acceptance to negligence. For example, David Stewart, who was the former executive director of the Central United States Earthquake Consortium (CUSEC) and the director of the Center for Earthquake Studies at Southeast Missouri State, Cape Girardeau, Mo. during the Browning prediction debate, gave full support to the prediction and contributed very effectively to the promulgation of Browning's prediction.[10 (pp.9-10)] Most of the regional seismologists, on the other hand, rejected the prediction. They even refused to consider it and called it simply "irresponsible".[10 (p.10)] NEPEC at first ignored the prediction, "deeming it scientifically insignificant"[10 (p.9)] and later denounced it.[10 (p.15)]

Emergency preparedness officers' views differed widely. Some took sides with the scientists who were critical of the Browning prediction while others thought that this prediction was sound. There were even some officials who considered this as an opportunity to increase public hazard awareness. This attitude, however, was met with severe criticism.[10 (p.10)]

The ethical problems concerning the Brady-Spence prediction, which have already been pointed out, are even more obvious in the Browning case. Unlike Drs. Brady and Spence, Iben Browning had no background at all in EPR. Furthermore, he had no unambiguous examples to support his so-called "success" in predicting earlier earthquakes.[11 (pp.622-3)] Even the general principle of free speech can hardly justify Browning's publicizing his scientifically unsupported opinions. John Stuart Mill, himself, admitted exceptions to the liberal principle of free speech: "[E]ven opinions lose their immunity when the circumstances in which they are expressed are such as to

constitute their expression a positive instigation to some mischievous act."[12 (pp.67-8)] There were reports of panic, hysteria and economical loss following the promulgation of Browning's announcements.[10 (pp.14-16,20)] Although describing the situation in terms of "panic" may seem to many sociologists and psychologists to be an exaggeration,[13,14,15] that there followed serious social disturbances after the publication of Browning's prophecy cannot be denied.[11 (p.622)] If causing public disturbance can be interpreted as a "mischievous act", then this publication cannot be defended on the principle of free speech.

It may, however, be argued that although the public may have been harmed, this event helped to increase public awareness of seismic risk in a region where this concept had previously been met with indifference. This argument presupposes that expert researchers on earthquake prediction were given an equal opportunity to explain to people that Browning's prediction is scientifically groundless.[10 (pp.15,22)] That they had found, or took advantage of this opportunity, however, is not certain. Even if we grant that they had found equal opportunity to speak in favour of good science, it is doubtful whether they were as convincing as Browning and Stewart. Spence *et al*., for instance, report, "after release of the NEPEC denunciation of the Browning prediction, the pace of announced school closings continued to increase."[10 (p.15)] It seems too optimistic to assume that "truth shall prevail," as scientific matters are discussed in a public forum. In such public forums rhetoric is more influential than scientific reason, and there is no guarantee that even cranks may not be more successful in persuading people that their unwarranted hypotheses are true. Mass media and the Internet do sometimes contribute to the dissemination of wild hypotheses by publicity seekers and cranks.

The attitude of justifying means by ends, as exemplified in the expectation that public hazard awareness may be increased by the publication of unwarranted hypotheses, is ethically questionable; for this view presupposes that deception can sometimes be justified if it realizes a considerable benefit. But is this not a violation of the people's right not to be treated as a mere means to some end? This violation becomes even more questionable if some public officials want to increase public sensitivity by "worst case scenarios". This was in fact the case in the New Madrid affair.

The Parkfield Experiment

Unlike the Brady-Spence and Iben Browning predictions, the Parkfield prediction was the result of community work supported by the USGS. W.H. Bakun and T.V. McEvilly were the first to recognize a recurring pattern in the Parkfield earthquakes.[16] Later Bakun and McEvilly proposed a periodic model for forecasting the next Parkfield quake.[17] Finally, Bakun and Lindh predicted with a 95% confidence level that a characteristic Parkfield earthquake of a magnitude 5.5-6 would occur in a 1988 ± 5.2 time window.[18] NEPEC did not hesitate to approve this prediction, although it had refused to endorse the Brady-Spence prediction in 1981 and later denounced Iben Browning's prediction in 1990. However, the predicted Parkfield earthquake has not

yet occurred. The data used for the Parkfield prediction make various other predictions plausible.[8,19]

The Parkfield prediction became the focus of seismic safety programs in California in the late 1980s. The geological experiment was turned into a social experiment by the combined efforts of the USGS and the California Office of Emergency Services (OES). The State of California revised the legal structure in order to make use of predictions and forecasts for public safety objectives.[20] Consequently, a public warning system with 5 status levels (A, B, C, D, E) was developed. OES was to issue a public warning when the USGS sends OES an A-level notification upon the observation of specified conditions.[21] So far, only two public warnings have been issued by OES.[22] The first A-alert level was reached six minutes after the B-level status initiated by an M 4.7 earthquake that occurred near Parkfield, on October 20, 1992, and this was interpreted by the USGS as a foreshock of the moderate size earthquake of 1985 official prediction.[21] John Langbein, a USGS scientist, is quite satisfied with the public response to the first warning and claims that this alarm was useful for testing the state's emergency response capability.[21] Richard Andrews, the director of OES at the time, also argues that the warning was an experiment that enabled officials to test their policies and the public response.[20] Andrews and Langbein say that no public panic was observed during the warning period.[20,21]

OES published a detailed brochure containing information about the prediction and instructions for earthquake preparedness and mailed it to about 122,000 households at risk. Dennis S. Mileti and Colleen Fitzpatrick[23] and Mileti *et al*.[24] examined the responses of a group of people in a number of selected counties at risk. Mileti *et al*. concluded that "[t]he Parkfield earthquake forecast was a public information success. … *whether or not the earthquake actually occurs.*"[24 (pp. 38-9; emphasis added)]

Although the Parkfield experiment is generally regarded as an exemplary case of cooperation between natural and social scientists and political authorities in hazard management and risk communication**,** their way of handling the issue seems to be ethically questionable. The OES brochure was meant to increase public awareness and facilitate risk communication. There are careful expressions in the brochure, such as the following: "[a] short-term prediction means that the likelihood of an earthquake occurring within a specified period has increased, not that an earthquake is certain to occur."[25] This statement informs the public on both the meaning and *limits* of short-term prediction. The brochure, however, fails to state the reliability of short-term prediction research itself; for, up to present, no short-term prediction based on the observation of precursors has been successful. Many scientists even hold that short-term earthquake prediction research is a failure or at least not realistic in the immediate future (see, e.g.[26-32]) Japan, in fact, after 20 years of short-term prediction research had to shift the focus of EPR to long-term forecast (see, e.g.[33-37]). The brochure, however, seems to have been written on the assumption that short-term prediction based on precursors is possible. Dennis S. Mileti and Lori Peek say that warnings should be very clear even about uncertainties.[15] Although the brochure makes it clear that an increased likelihood does not mean that an earthquake *will occur*, it fails to mention the current

scientific status of the short-term prediction research.[a] The reason for this silence is probably the concern of the scientists and public authorities that people might disregard warnings if the failure of the short-term prediction paradigm were stated. It is evident that such a policy in risk communication is susceptible to ethical criticism. For people concerned are here denied their right to know that the social experiment, of which they are a part, is connected to a geological experiment that rests on a highly dubious seismological paradigm. Those who conduct the social experiment may argue that their concern is to increase public awareness. Accordingly, they may justify their omission of the questionable scientific status of the short-term prediction research by appeal to a consequentialist argument that a good end justifies the means. This consequentialism, however, is a crude one, for it fails to take into account all consequences and side effects.

Let us try to assess the Parkfield experiment with this consideration in mind. Suppose that the silence of the authorities concerning the unreliability of the short-term EPR is outweighed by the increase in public hazard awareness. The balance between the means and the end may, however, be upset if people in the area feel deceived about the reliability of the geological hypothesis. This would engender serious doubts about the future experiments as well as about the credibility of scientific and public authorities. Further, this consequentialism can be defied by a "rights view" argument that people who are said to be under risk are treated as a mere *means* to some end, albeit that end is supposed to be the public's own benefit.

A further ethical question concerns false alarms. Two public warnings (A-level alerts) issued in 1992 and 1993 in the Parkfield area happened to be false alarms. Mileti and Peek think that although false alarms are usually regarded as troubles, many of them, in fact, may be used as "opportunities" to increase public hazard awareness if their failure is clearly explained to people.[15] Andrews[20] and Langbein[21] argue that the public was not seriously alarmed or upset by these false alarms. However, Olson and Olson, argue regarding the Brady-Spence prediction in Peru that the prediction caused a temporary "popular anxiety", but it "had no sustained impact either positively or negatively."[6 (p.130)] This observation does not seem to support Mileti and Peek's above claim. But it seems that the right policy to increase public awareness would be conducting earthquake drills rather than "training" people by false alarms. Otherwise, it would be possible to consider false alarms in the Brady-Spence and Iben Browning cases as opportunities to increase public hazard awareness. For instance, the director of public safety in Sikeston, Missouri, said that "[e]ven if [Iben Browning] isn't correct, he's doing a great service for emergency preparedness, because people are finally listening."[10 (p.10)] An official at Memphis State's Center for Earthquake Research and Information complained about this attitude:

a. A survey by the Prime Minister's Office in Japan in 1996 revealed that only 44.5% of Japanese people believe that earthquakes are unpredictable.[37] Miscommunication of EPR seems to make many people believe that earthquakes are predictable. Scientists and public authorities, however, have a positive duty to inform people about the present inability to predict earthquakes, and that there are no prospects for the near future. If they fail to do this, they contribute to people's deception about EPR.

> Some state and local emergency management agencies, unsure about the legitimacy of the prediction, unwittingly gave it credibility by using it as an opportunity to promote earthquake preparedness. In some areas, these agencies helped to increase anxiety levels by presenting worst-case scenarios as a highly probable consequence of a major earthquake.[10 (p.10)]

Conclusion

The analyses of the Brady-Spence and Iben Browning cases suggest that publication of scientifically unwarranted hypotheses that are of immediate public concern cannot be justified by appealing to a principle of absolute freedom of speech, for such a publication may lead to social disturbances. Furthermore, the public sensitivity caused by such publications should not be seen as an opportunity to promote public awareness because this policy rests on a short-sighted consequentialism which takes it for granted that any means can be justified by any end. This policy can also be criticized from a rights view according to which individuals should never be treated as a mere means to ends. A similar criticism can be brought against the public policy in the Parkfield case, for the people concerned were not informed that the whole experiment was based on a contested seismological paradigm. Those who conduct such social experiments should never forget that they deal with autonomous human beings who have the right to know what they are involved in.

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