

“まだ蜃気楼を見ないの？”

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“まだ蜃気楼を見ないの？”。そんな風に聞かれても多くの方にとって「簡単に見ることができない」と思われている蜃気楼。実は身の回りであって、見えていても蜃気楼だと気がついていないことの多い現象です。さて、山下麻衣+小林直人の展覧会タイトル「蜃気楼か。」は、芥川龍之介の短編小説「蜃気楼」（昭和2〔1927〕年）の一節からとられています。この小説中の蜃気楼の表現をたどりながら、「蜃気楼」がどのような現象か紹介していきます。

“鶴沼の海岸に蜃気楼の見えることは誰でももう知つてゐるであらう。現に僕の家の中などは逆さまに舟の映つたのを見、「この間の新聞に出てゐた寫真とそつくりですよ。」”（芥川龍之介「蜃気楼」）

と小説のはじめに、鶴沼（神奈川県藤沢市）の蜃気楼が話題となります。

蜃気楼というと、普段見えないものが急に見える現象と思っている方もいると思います。しかし、蜃気楼は普段の景色が伸びて見えたり、ひっくり返って見えたりする現象で、突然そこにない風景や建物が見えるわけではありません〔写真1〕。つまり普段の景色がどのようになるのかを知らないと気づくことができない現象です。

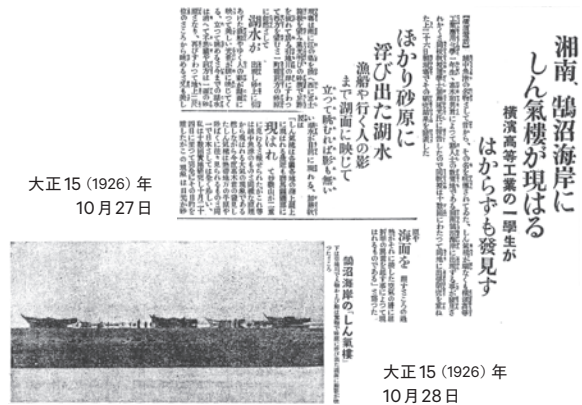
小説内で女中が“寫真とそつくり”と言っています。逆にそれは、蜃気楼によって、舟の下に舟がひっくり返って見えることを新聞写真で知っていたから、注意深く風景を観察し気づくことができたのかもしれません。



〔写真1〕 魚津から見られる富山火力発電所（上）・新湊大橋（下）の蜃気楼

小説中でこの女中が見たと考えられる新聞写真がありました。それは、大正15（1926）年10月27日と翌28日の東京朝

日新聞で、鶴沼で蜃気楼が見えた記事と写真が紹介されました〔写真2〕。



〔写真2〕 鶴沼の舟の蜃気楼（東京朝日新聞より）

ここで、蜃気楼について整理してみましょう。蜃気楼は密度（≒温度）の著しく異なる大気の中で、光が曲げられること（屈折）で、普段の景色が変わって見える現象です。蜃気楼は、上位蜃気楼と下位蜃気楼に分けられます。上位蜃気楼は、光の屈折で普段の景色の上に伸びたり、反転した虚像が現れるものです。一方、下位蜃気楼は、普段の景色の下に反転した虚像が現れます。この下位蜃気楼には、暑い日に道路などで見られる「逃げ水」や、景色が浮かんで見える「浮島現象」も含まれます。

先の新聞の舟の写真は、後者の下位蜃気楼です〔写真2〕。また、27日の記事では、鶴沼の蜃気楼は、越中魚津の蜃気楼とは異なり、熱帯地方の平原や砂漠に見えるものと同じと書かれています。その通りで、富山県魚津市で、歴史的に有名なのは春に見られる上位蜃気楼で、砂漠等で見られる下位蜃気楼（逃げ水）とは異なります。

さて、“地上二尺位のところから眺めると又も美しい湖水が目前に現れる”と先の新聞記事にありました。二尺（約60cm）の視点で、屈んでみると見やすかったということです。下位蜃気楼は暖められた地面や海面付近の空気と、その上の比較的冷たい空気との温度差が作る現象で、視点が低いほど見えやすくなります。

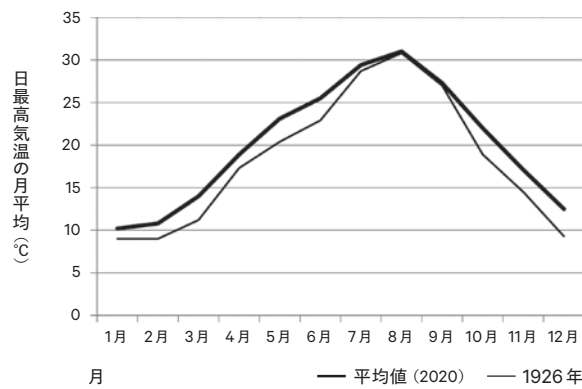
実際に、下位蜃気楼（逃げ水）が見える距離を光学的に計算*1すると、視点の高さが60cmでは約100m先から、通常の立っ

た視点の高さ1.5mでは約250m先から下位蜃気楼（逃げ水）が見えるので、視点を下げることがより近くの蜃気楼を認知できることになります。

“蜃気楼の見える場所は彼等から一町ほど隔つてゐた。僕等はいづれも腹這ひになり、陽炎の立つた砂濱を川越しに透かして眺めたりした。砂濱の上には青いものが一すぢ、リボンほどの幅にゆらめいてゐた。”

陽炎は、空気の密度差で風景がゆらめいて見える現象で、蜃気楼とは異なります。陽炎は暑い日の道路や車のボンネットの上、火にかけたやかんの周りなど注意して見ると出会えます。さて、彼らは蜃気楼の見える場所から一町（約109m）ほど隔てたのは、なぜでしょうか。腹這いで一町先に蜃気楼が見えるか先ほどと同様の計算*1を試みましょう。

主人公らは、大正15（1926）年10月末の新聞記事が出た後“或秋の午頃”（小説冒頭より）に、蜃気楼を見に鶴沼の海岸へ行ったと考えられます。鶴沼がある神奈川県では大正15（1926）年の気温が横浜（中区海岸通一丁目〔海拔0m付近〕）で、昭和2（1927）年以降は中区山手町（海拔39.1m）で観測されています。“午頃”は1日の内で、最も気温の高い時間帯です。11月の日最高気温の平均*2をみると大正15（1926）年は14.5℃で、近年の平年値の17.1℃よりずいぶん低いことがわかります〔図1〕。



〔図1〕 横浜の日最高気温の月平均値

気温は14.5℃でも、地面は日射に照らされて気温よりも20℃くらい高くなることもあります。“腹這い”になったので約30～60cmくらいの視点から蜃気楼を見ていたとすると、約

50～100m先には下位蜃気楼（逃げ水）が見えていたと計算*1されます。つまり、“一町”（約109m）ほど隔てたところから“青いものが一すぢ、リボンほどの幅にゆらめいてゐた”と下位蜃気楼（逃げ水）を見たというのは妥当な距離と考えられます。

“K君は顎を砂だらけにしたなり、失望したやうにかう言つてゐた。そこへどこからか鴉が一羽、二三町隔つた砂濱の上を、藍色にゆらめいたものの上をかすめ、更に又向うへ舞ひ下つた。と同時に鴉の影はその陽炎の帯の上へちらりと逆まに映つて行つた。”

この時すでに、K君は立ち上がっていたのかもしれませんが。それは、1.5mの立った視点からは、約240m先に下位蜃気楼（逃げ水）が見えるはずで、“二三町”（約218～327m）隔てた砂濱で鴉が逆さまに映って見えた（下位蜃気楼になった）というのはもっともらしいからです〔写真3〕。

これらから、芥川の小説内の蜃気楼は下位蜃気楼で、大気光学的な計算とも一致し、実体験をもとに描かれていると考えられます。

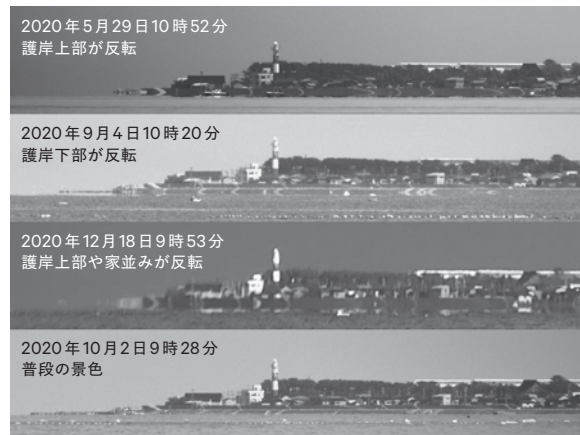


〔写真3〕 砂浜で見られたサーファーの下位蜃気楼（2018年11月23日、千葉県九十九里町）

今回の展覧会で発表される「infinity ~ mirage」（山下麻衣+小林直人、2021）は、この芥川の「蜃気楼」の中で描かれたような下位蜃気楼を用いた作品です。「infinity ~ mirage」のインスタレーション展示は、富山県黒部市生地の護岸に設置されるm型看板が基軸となります。展示期間と同じ時期（2020年9月から12月〔78日間〕）、富山県魚津市沿岸のライブカメラで*3、生地の護岸に下位蜃気楼が日中見えるか観察しました。すると86%にあたる67日間、下位蜃気楼を確認できました。つまり、生地の護岸は著しく気温の高い日などを除くと普段から下位蜃気楼になっていました。しかし、下位蜃気楼となった生地の護岸の見え方は日によって大きく異なりました〔写真4〕。

“Haven't you seen a mirage yet?”

Masaki Sato Curator, Uozu Buried Forest Museum

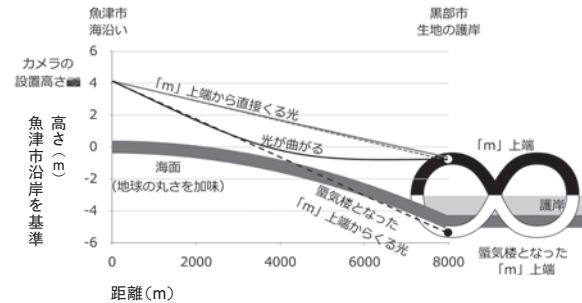


[写真4] 黒部市生地の下位蜃気楼と普段の景色

そこで、下位蜃気楼が見られる時、「m」型の看板を「∞」と見せるインスタレーション《infinity ~ mirage》が可能かどうかを松井一幸氏による光路計算方法*4で算出し、木下正博氏による別の手法*5でその結果を検証しました。

魚津市沿岸にある「海の駅蜃気楼」の海拔約4mの場所にカメラを設置。このカメラと「m」型の看板(幅14.1m×高さ2.3m)を設置する生地の護岸は約8km離れています。そして、地球は丸いので、遠くにある「m」上端は魚津市沿岸を基準とすると高さ-0.75mになります。この「m」上端が真下に反転するには、高さ4mと海面付近で約1.9°Cの温度差が必要と算出されました[図2]。このような温度差があると、「m」上端(○)からの光は黒線のように空気中で曲げられます。光が曲がると実際には、黒破線の先に「m」上端(●)があるように見えます。さらに、「m」上端から直接くる光(灰色線)も見えるので「m」と逆さの「m」が合わさって「∞」に見えると考えられます。

ただし、この計算の中では、大気の湿度や気圧、温度変化構造など多くの要素を仮定し、近似を用いたので計算通りではないかもしれません。展覧会期間中に「m」が「∞」になる日はあるのでしょうか。



[図2] 「m」型の看板の下位蜃気楼の光学的な計算

ある夏の暑い日に、小学生らと下位蜃気楼(逃げ水)を見に出かけました。「視線を下げると逃げ水を見つけやすいよ」と話す、しゃがむだけではなく、灼熱のアスファルトの上に腹這いで逃げ水を探していた小学生。芥川が描いた「蜃気楼」の文学的な意味は他に任せるとして、「蜃気楼まだ見えないかな」と、視点を変えると変わって見える蜃気楼をいろいろなところで楽しんでみてはいかがでしょう。

(さとうまさき、魚津埋没林博物館学芸員)

- * 1 | 水野量「逃げ水の距離について」『東北技術だより』、1984年
- * 2 | 「過去の気象データ検索」国土交通省気象庁ウェブサイト、<https://www.data.jma.go.jp/obd/stats/etrn/index.php>
- * 3 | 蜃気楼ライブカメラ、<https://www.city.uozu.toyama.jp/nekkolnd/live/>
- * 4 | 松井一幸「下位蜃気楼シミュレーション」ピワコダス松井ウェブサイト、<https://biwakodas.sakura.ne.jp/mirage/NewInferiorMirageCalculation.htm>
松井一幸「上位蜃気楼変化から見る境界層の動的振る舞いの理論的考察」『日本蜃気楼協議会研究発表会要旨集(平成27年)』日本蜃気楼協議会、2015年
- * 5 | 木下正博「富山湾における蜃気楼の研究とその教材化」平成12年度富山大学大学院教育研究科修士論文、2001年

“Haven't you seen a mirage yet?” For many people who are asked this question, a mirage is considered to be not an easy thing to see. In fact, it is a phenomenon that is all around us, and even if we see it, we often do not realise that it is a mirage. The title of Mai Yamashita + Naoto Kobayashi's exhibition, A mirage. is taken from a passage in Ryunosuke Akutagawa's short story *Mirage* (1927). Let us trace the expression of mirage in this novel, and introduce the phenomenon of mirage.

The mirage of Kugenuma (Fujisawa City, Kanagawa Prefecture) is mentioned at the beginning of the novel:

“Everyone must have already known that mirages can be seen on the beach of Kugenuma. My maid, for example, saw the reflection of a boat upside down and said, “That’s just like the picture in the paper the other day.””

(from *Mirage* by Ryunosuke Akutagawa)

Some people might think of a mirage as a phenomenon in which something normally invisible suddenly appears. However, a mirage is a phenomenon in which an ordinary landscape appears stretched or turned upside down, and not the sudden appearance of a landscape or building that is not there [Image 1]. In other words, it is a phenomenon that can only be noticed if you know what the usual scenery looks like.

In the novel, the maid refers to it as “just like the picture”. Perhaps because she knew from the newspaper photograph that mirages can cause boats to appear upside down, she was able to observe the landscape carefully and notice the phenomenon.



[Image 1] Mirage of Toyama Thermal Power Station (top) and Shinminato Bridge (bottom) seen from Uozu

Here is the newspaper photograph that the maid in the novel might have seen. These are The *Tokyo Asahi Shimbun* articles and a photo of a mirage in Kugenuma, published on 27th and 28th of October in 1926 [Image 2].

1 |
27 October 1926



[Image 2] Mirage of boats in Kugenuma (from The Tokyo Asahi Shimbun)

1 | [Headline]
A lake emerged floating on a sandy plain. Even the shadows of fishing boats and passers-by are reflected on the surface of the lake. If you stand and look, however, there is no trace.

2 | [Headline]
A mirage appeared on Kugenuma beach in Shonan. The mirage was discovered by a student of Yokohama Technical High School.

Let's get a few things straight about mirages. A mirage is a phenomenon in which light is bent (refracted) in an atmosphere of significantly different density (= temperature), showing the usual view differently. Mirages can be divided into superior mirages (upper mirages) and inferior mirages (lower mirages). A superior mirage is one in which the refraction of light causes a virtual image to appear stretched or inverted above the normal scenery. On the other hand, an inferior mirage is an inverted virtual image that appears below the normal view. These inferior mirages include the “water mirage” seen on roads on hot days and the “floating island phenomenon”, in which the landscape appears to float.

The photograph of the boat in the newspaper is showing an inferior mirage [Image 2]. In the article of 27th October, it is written that the mirage of Kugenuma is different from the mirage of Uozu, and is the same as that seen in the plains and deserts of the tropical regions. This is true, and in Uozu, Toyama Prefecture, the historically famous mirage is the superior mirage seen in spring, which is different from the inferior mirage (water mirage) seen in deserts, for instance.

“When looking at the sandy plain from about 2 shaku length above the ground, miraculously a beautiful lake would appear in front of the eyes,” says the newspaper article. According to the article, the mirage is easier to see if you bend down to look at it from 2 shaku length (about 60 cm) above the ground. A inferior mirage is created by the difference in temperature be-

tween the warmed up air near the ground or sea surface, and the relatively cold air above it. The lower the viewpoint, the easier it is to see.

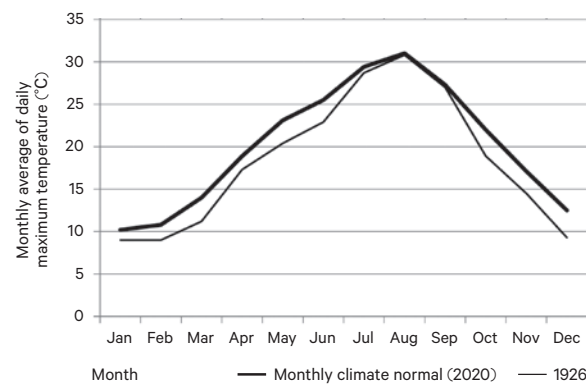
In fact, an optical calculation [1] of the distance at which the inferior mirage can be seen shows that the inferior mirage can be seen from about 100 m away at a viewpoint height of 60 cm and from about 250 m away at a normal standing viewpoint height of 1.5 m. Therefore, lowering the viewpoint means that the mirage can be perceived more closely.

“The place where the mirage was visible was about 1 cho away from them. We all lay on our stomachs and looked through the river at the sandy beach with a heat haze. Above the sandy beach was a strip of blue shimmering as wide as a ribbon.”

A heat haze is a phenomenon in which the landscape appears to shimmer due to differences in air density, and is different from a mirage. It can be seen on the road on a hot day, on the bonnet of a car, or even around a kettle on a fire if you carefully observe. So, why do they stay at a point which is 1 cho (approximately 109 m) away from the mirage? Let us do the same calculation *1 as before, to see if we can see a mirage from 109 m away by lying on our stomachs.

The main character and his friends must have gone to the beach of Kugenuma “At noon one autumn day” (according to the beginning of the novel) to see the mirage after the newspaper article was published at the end of October in 1926. In Kanagawa Prefecture, where Kugenuma is located, the temperature in 1926 was observed at 1 Kaigan-dori, Naka-ku, Yokohama (about 0m above sea level), and after 1927 at Yamate-cho, Naka-ku (39.1m above sea level). Around noon is the hottest time of the day. The average daily maximum temperature in November *2 was 14.5°C in 1926, which is much lower than the recent average of 17.1°C

[Figure 1].



[Figure 1] Monthly average of daily maximum temperature in Yokohama

Even if the temperature is 14.5°C, the ground can be 20°C higher than the temperature due to solar radiation. If “lying on our stomachs” and seeing the mirage from a viewpoint of about 30 to 60 cm above from the ground, based on the calculation [1], the inferior mirage could have been seen about 50 to 100 m away. So it seems reasonable to say that they saw the inferior mirage as “a strip of blue shimmering as wide as a ribbon” from a distance of “1 cho” (about 109 m).

“K said disappointedly, having his chin covered with sand. Then, from somewhere, a crow skimmed over the shimmering indigo blue on the sandy beach, 2, 3 cho away, and danced down further. Suddenly, the crow’s shadow flickered upside down over the shimmering band of heat haze.”

At this time, K may have already been standing up. This is because, from a standing point of view of 1.5 m, the inferior mirage should be visible about 240 m away, and it is plausible that the crow was reflected upside down as an inferior mirage at the sandy beach “2, 3 cho” (about 218 to 327 m) away [Image 3].

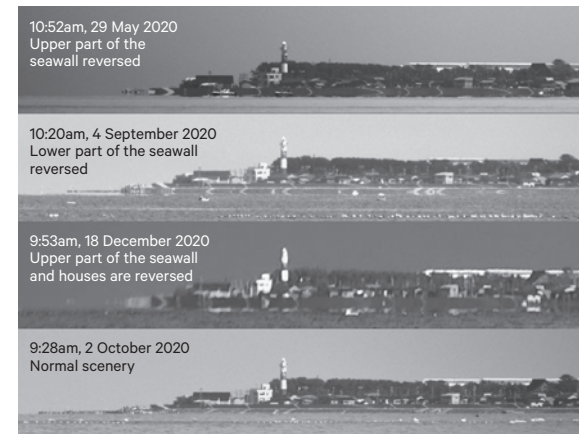
These facts suggest that the mirage in Akutagawa’s novel is an inferior mirage, which is consistent with atmospheric optical calculations and quite probably described based on actual experience.



[Image 3] Inferior mirage of surfers seen on the beach (Kujukuri-machi, Chiba Prefecture, 23 November 2018)

The work entitled *infinity-mirage* (by Mai Yamashita + Naoto Kobayashi, 2021), which is presented in this exhibition, uses inferior mirages that are depicted in Akutagawa’s *Mirage*. The installation of *infinity-mirage* is based on an m-shaped sign which is installed on the seawall in Ikuji in Kurobe City, Toyama Prefecture. During the same period as the exhibition period (September to December 2020, for 78 days), we used a live streaming camera on the coast of Uozu City in Toyama Prefecture *3 and examined whether the inferior mirage on the seawall of Ikuji could be seen during the day. We observed the inferior mirage for 67 days, which is 86% of the time period. In other words, the seawall of Ikuji appeared usually as an inferior mirage except for

days with extremely high temperatures. However, the visibility of the inferior mirage of the seawall of Ikuji varied greatly from day to day [Image 4].

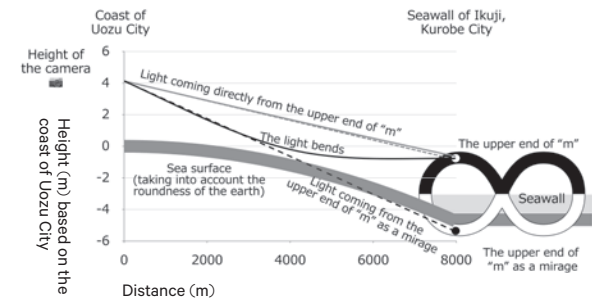


[Image 4] Inferior mirage and normal scenery of Ikuji, Kurobe City

We calculated whether it is possible to create an installation *infinity-mirage*, in which an “m” shaped sign is shown as “∞”, when a inferior mirage can be seen, using optical path calculation method developed by Kazuyuki Matsui *4, and verified our result using another method developed by Masahiro Kinoshita *5.

A camera is installed at the The Marine Station: “Mirage” (Shinkiro) on the coast of Uozu City, about 4 m above sea level. This camera is about 8 km away from the seawall of the Ikuji on which the “m” shaped sign (14.1 m wide × 2.3 m high) are installed. And because the earth is round, the top of the “m” in the distance is -0.75m high, when taking the coast of Uozu City as a basis. In order for the top of the “m” to flip downwards, a temperature difference of about 1.9°C near the sea surface and a height of 4m are required [Figure 2]. With such a temperature difference, the light at the top of the “m” (○) is bent in the air as shown by the black line in the chart. When the light is bent, it actually looks as if the upper end of “m” (●) is further than the black dashed line. In addition, as we can see the light coming directly from the upper edge of “m” (grey line), it is safe to say that “m” and the upside-down “m” will be combined and appear to be “∞”.

Yet, in this calculation, many factors such as atmospheric humidity, pressure and temperature change structure were assumed and approximations were used, so the calculation may not be correct. Will there be days during the exhibition when “m” becomes “∞”?



[Figure 2] Optical calculation of the inferior mirage for the “m” shaped sign

At noon one summer day, I took a group of schoolchildren out to see the inferior mirages. When I told them “It would be easier to find a mirage if you lower your eyes”, they not only crouched down but also lay on their stomachs on the scorching asphalt in search of a water mirage. Leaving the literary meaning of Akutagawa’s mirage to others, why don’t we enjoy the mirage in various places, which looks different when we change our point of view, while wondering if and when you can see it?

- * 1 | Hakaru Mizuno “On the distance of water mirage,” in *Technical letters of Tohoku district* (Sendai: Sendai District Japan Meteorological Observatory, 1984) .
- * 2 | “Historical weather data search,” Japan Meteorological Agency website. <https://www.data.jma.go.jp/obd/stats/etrn/index.php>
- * 3 | Mirage live camera. <https://www.city.uozu.toyama.jp/nekkolnd/live/>
- * 4 | Kazuyuki Matsui “Inferior Mirage Simulation,” BiwakoDas Matsui’s website. <https://biwakodas.sakura.ne.jp/mirage/NewInferiorMirageCalculation.htm> Kazuyuki Matsui “Theoretical Consideration of dynamic behaviour of boundary layer from the viewpoint of superior mirage change,” *Proceedings of the General Meeting of the Japan Mirage Association* (Japan: Japan Mirage Association, 2015) .
- * 5 | Masahiro Kinoshita, “Study of mirage in Toyama bay and its teaching material,” Master’s thesis, Graduate School of Education, University of Toyama, 2001.