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Foreword

In management (and control) the most important factor is a thorough knowledge of the behavior (properties, dynamics) of the managed object. In technical systems these properties can be (to a sufficient extent) formally described. In the socio-economic system this can not be done so easily. This is where games of various kinds can convey the "feeling" of the systems behavior in a very instructive way. The two games presented in this working paper are of that kind. They show, at the same time, how one can turn the constantly extending properties of microcomputers into a greater sophistication of the game.

Both games carry important messages for those who are in the process of managing common resources. This property should make this working paper by Professor Baba useful to a wide community.

Tibor Vasko
Leader
Clearinghouse Activities

TWO MICRO–COMPUTER BASED GAMES

Norio Baba, Yoshikazu Sawaragi**, Hiroshi Takahashi***, Eiji Nakamura*** and Kunihiko Machida****

1. Introduction

Human activities have strong effects upon environmental changes. If we only pursue industrial development (and/or selfish utilization of natural resources) and do not care much about environmental protection, serious deterioration of the environments would occur.

In this paper we present the two Microcomputer Games that deal with the serious environmental problems. Since these games are in a dialogue mode and the Microcomputer screen presents plenty of beautiful color graphics, it should contribute, in an interesting and helpful manner, to the increased awareness of the environmental issue.

The organization of the paper is as follows:

In the first part we present the Microcomputer Game that deals with the red tide problem known as one of the most serious environmental changes at the innerland sea. After the detailed explanation for the rules of the Game, the results of the gaming experiment that was carried out in the Microcomputer room of Tokushima University, Japan, is described.

In the second part of the paper we present the Microcomputer Gaming System which is a modified version of the COMMONS Game by Powers *et al.* (1980). Following the brief introduction of the original COMMONS GAME, we will explain this Microcomputer Gaming System and give the experimental results obtained in the

Tokushima University. Further, we will briefly touch upon our trial to make this Microcomputer Games much more interesting. In the last part of the paper we will discuss the merits and demerits in using the Microcomputer game for the serious environmental issues we are facing.

2. A Description of the Environmental Game dealing with the Red Tide Issue

2.1. Microcomputer Gaming System

In our Microcomputer Gaming System players represent the directors of the four chemical companies whose factories are facing the sea. Since the sea is surrounded by land on all sides, all company management decisions can strongly affect the environmental state of the sea. If they invest lots of money to improve their financial state, without giving due consideration to the possible deterioration of the sea because of this invest, a serious environmental situation could emerge. Therefore, they must manage their company in such a way as to avoid the environmental deterioration of the sea.

Figure 1 presents a model layout in our Microcomputer game. This game is played on the NEC 9801 F2 Microcomputer (Japan), but it can easily be transformed to be played on other microcomputers – Apple, IBM PC 5550, etc. As the game is "user friendly" even people who have little knowledge regarding computers can become players (and/or game director).

2.2. Objectives of the Game

The game is designed to:

(1) help people to learn about the red tide issue at an innerland sea,

(2) give people a chance to manage a company whose factories are facing the innerland sea.

2.3. Detailed Explanation for the Rules of the Game

The game can be played for more than 20 years with one game director and four players – representing the four companies facing the innerland sea. At the beginning of the first year an equal amount of money, for example \$1000, is given to each of the four players. Each player must then decide how much he should invest for producing chemical goods and how much to avoid environmental deterioration.

In each round players should decide the following three values:

I: The amount of money to be invested for producing chemical goods.

Z: The amount of money to be saved for constructing new equipment for decontamination.

U: The amount of money to be utilized for operating the current equipment for decontamination.

Since there are three kinds of chemical goods, each player should specify, in deciding the value of I, in which chemical good he will invest. The first chemical good G_1 may cause large profits with some risks. The third chemical good G_3 would only produce small profits (but with rather high probability). The second chemical good G_2 can be considered as the one taking the position in between G_1 and G_3. In other words, investment for producing the first chemical good means speculation in some sense and the others mean sound management. Let us explain this more clearly. In each round the game director receives a paper from each player on which the values of I, Z, and U are written. He then inputs (from the microcomputer keyboard) all of these values into the microcomputer. If he pushes the RETURN key 2 dices rotate and stop (Figure 3). The amount of money invested in each chemical good increases or decreases depending upon the sum of the numbers of the 2 dices.

Assume that the ith player invests at the kth round $I_1^i(k)$, $I_2^i(k)$, and $I_3^i(k)$ on G_1,G_2, and G_3, respectively (Figure 2). If the sum of 2 dices happens to be 3, 4, or 5, he receives

$$I_1^i(k) \times (2.2 + \xi_1^i(k)) + I_2^i(k) \times (1.00 + \xi_2^i(k)) + I_3^i(k) \times (1.10 + \xi_3^i(k)) ,$$

where $\xi_j^i(k)$ ($j = 1,2,3$) are normally distributed random variables with zero mean. If the sum of 2 dices happens to be from 6 to 11, in the average $I_1^i(k)$ decreases and $I_2^i(k)$ (or $I_3^i(k)$) increases (Figure 2). If the sum of 2 dices becomes 2 or 12, he receives

$$I_1^i(k) + I_2^i(k) + I_3^i(k)) \times (1.5 + \xi_4^i(k))$$

where $\xi_4^i(k)$ is normally distributed random variables with zero mean.

The probability that the sum of 2 dices happens to be 3, 4, or 5 is considerably small. Therefore, investment in the first chemical good G_1 is rather risky. However, it may produce a large amount of profits. On the contrary, the investment on the third (or second) chemical good means sound management. (Even if the sum of the 2 dices happens to be 3, 4, or 5, the total amount of money invested in G_2 or G_3 does not decrease so much).

The microcomputer screen, as described in Figure 4, gives players in each round various information – the state of the sea (environment), the financial state, and business forecasting. If the players invest their money only to gain profits, and do not care about environmental protection, the environmental state declines and the color of the sea becomes tinged with yellow. If they continue with such a selfish Decision over several years, a red tide may appear on the sea near their factories. If they change their policy and care about environmental protection the red tide may disappear, in several years. However, if they still continued to invest a lot of money to produce chemical goods and none for environmental protection, they would be ordered to cease all operations at their factories.

The game can end in two ways:

(1) If serious environmental deterioration of the sea occurs, the game terminates and each player loses money. The top right hand corner of Figure 4 shows that there are 16 environmental states of the sea. (1 is the best state, and 16 the worst). The initial environmental state of the sea is 6. Depending upon the policies chosen by the players, the environmental state of the sea becomes better or worse. If the environmental state of the sea advances to the 16th state, the game comes to an end, as it indicates that environmental catastrophe has occurred. All players lose their capital.

(2) The game comes to an end between the 21st and 30th round. (Each round has an equal probability 0.1 with which the game terminates). The player who gets the largest amount of money wins the game.

As the game proceeds the players receive various instructions from the microcomputer. For example, in several rounds the player has contributed most to environmental protection is honored and given an amount of money by the government (see Figure 6). When the environmental deterioration of the sea becomes a serious problem, players are asked to pay consolation money to the fishery's party. The players should decide the amount of consolation money taking into account the damages he may have caused the fishery's party. If the amount decided by him is not enough, he will be asked to pay an additional amount (see Figure 7).

After every 5 turns the players have a conference time. As shown in Figure 8, they are given information concerning concerning how they have influenced the environmental deterioration. The game director, and all of the players, should evaluate the decisions made by each player during the last 5 rounds. They should choose an integer from -2 to 2 and write it on a sheet of paper provided by the game director. (2 (-2) means the best (worst) contribution to environmental pro-

tection). Each player should write 0 for his own score. The game director receives the sheets from the players and inputs all of these scores (including his own scores) from the keyboard of the microcomputer. If the total score of a player is less than -4, he has to pay a penalty. If the total score of the player is larger than 4, he receives an award (money).

2.4. Playing the Game

This experiment was carried out in the Microcomputer Room of Information Science and Systems Engineering, Faculty of Engineering, Tokushima University, Japan, on the afternoon of February 15, 1985. One of the authors was the game director, four students of the Tokushima University were assigned by lottery the role of one of the four companies whose factories face the innerland sea. Before running the game, the director explained the rules, this took about 20 minutes. Two game rune were carried out, each lasting about one and a half hours. The first game ended at the 29th round, the second at the 21st round. The changes of the environmental state and the amount of money gained by each player are described in Figures 9 to 12. These game runs were followed by a discussion with the participants. The students all agreed that the microcomputer game has an educational effect for the environmental problem, and is also quite helpful because it makes them aware of the red tide issue. They were impressed by the color graphics in the microcomputer screen, and found the game playing very interesting.

3. A Microcomputer Gaming System of the Commons Game

3.1. Original COMMONS GAME

The Commons game developed by Powers *et al.* (1980) is an educational game intended to help people learn abouts "commons". Since we live in a world having only finite natural resources, it is wise to consider the "wise utilization" of natural

resources. The Commons game may be very helpful in stimulating discussions on this problem.

In the following, we give a brief introduction to this game. Six players are asked to sit around a table. Following a brief introduction of the game, the game director tells the players that their objective is to maximize their own gains. During the first three rounds players can play only with a green or red card. After the three rounds, they are free to play one of the five cards – green, red, orange, yellow, and black. In each round, players show their cards behind a cardboard shield to ensure individual privacy.

Each colored card has its own special meaning, and has the following effect upon the total gains of each player:

(1) Playing a green card represents high exploitation of the commons. Players who play a green card can get a maximum reward. However, they lose 20 points if one of the other players plays a black card in the same round.

(2) A red card represents a careful utilization of the commons. Red card players can only get about forty percent as much as green in each round.

(3) A black card has a punishing effect on the green players. Players who have played a black card have to lose point 6 divided by the number of black players, but are able to punish green players by giving them -20 points.

(4) A yellow card represents a complete abstention from the utilization of the commons. Players who play this card can get 6 points.

(5) Orange cards give an encouraging effect to red players. Players who have played this card have to lose point 6 divided by the number of orange cards, but are able to add 10 to red players points.

Depending upon the players' strategies, the state of the commons change. if players are too eager to exploit the commons, then deterioration occurs. Players have a chart on the board representing the payoffs for the red and green cards under different conditions of the commons.

Although players are informed that there will be 60 rounds, each game ends after 50 rounds. After each 8th round, players have a three minute conference. They can discuss everything about the game and decide every possible way to play in future rounds.

Because of space limitations, the details of the rules are not explained. For those interested, however, we recommend reading the paper written by Powers *et al.* (1980).

3.2. The Microcomputer Gaming System

In the summer of 1983, two of the authors participated in the game playing carried out in the Seminar Room, IIASA, Laxenburg. The play was, of course, very interesting, and also gave us a valuable chance to consider the commons game. We felt, however, it would be helpful to have a microcomputer gaming system of the commons game with color graphics. Since then, we constructed a microcomputer gaming system, and completed this work recently.

In the following, let us briefly explain this microcomputer gaming system. Figure 13 presents a model layout of our microcomputer game.

In order to insure individual privacy, the game director provides each player with a paper in which a table, as shown in Tables 1-6, is drawn. Each player points out a column and row number in his table, in turn, instead of playing colored cards. (For instance, if the player 3 points out 5 – 4, it means he plays an orange card). Since the arrangement of each table is completely different, players can not get information about each others decisions. The game director, or an assistant, uses

a microcomputer keyboard to input the data of each round.

A microcomputer screen, as described in Figure 14, gives players various information, such as the state of commons and points received by players in each round. (If the state of the commons declines, the color of the waves becomes tinged with yellow. On the contrary, the color of the waves becomes tinged with blue if the state of the commons ameliorates). During the conference time, a microcomputer screen provides players with beautiful colored graphics, and also gives information about the times passed (Figure 15). This color graphic indicates the state of the commons. (The heavier the deterioration of the commons becomes, the more the earth is painted out by red).

In our microcomputer gaming system, a game director has the option of making the total points of the players public, or of keeping them secret). Therefore, a game can consider various ways of game playing. For instance, he could consider the game playing in which the total gains of the players are kept secret during the play of the game (Figure 16). He could direct the game playing in which the total gains of the players are made public during all rounds of the game (Figure 17). He could also have a game playing that is dependent upon players preferences. (If players agree with changing the way of game playing in the conference time, they can ask the game director to change the game playing way, and he can do this easily).

The computer program is written in N-Basic, it can only be used on the NEC 9801 microcomputer system. However, it can be transformed easily to the program for other microcomputers such as Apple and IBM. Since this program is rather lengthy, we omit it in this paper. Interested readers may ask one of the authors of this paper.

3.3. The Playing of the Microcomputer Game

The first experiment was carried out in a small room of Information Science and Systems Engineering, Faculty of Engineering, Tokushima University, on the evening of December 23, 1983. Six 4th year students of the university, and two of the authors, participated. One author was the game director. He explained the microcomputer gaming system and the way to play, this took about 10 minutes. He wanted to see the game playing in which the total points of all players in each round was made public through the microcomputer screen. Two game runs were carried out, it took about one and a half hours for each game, with a one hour break between the two game runs. (One author was an onlooker).

Figures 18 and 19 present the changes of the total gains of each player in the first and second game runs, respectively. The total points of the players in the second game run were higher than those in the first game run. Figures 20 and 21 present the color rate that was used during the game runs. The rate of red color in the second game run was higher than in the first game run. The rate of green color decreased in the second game run. Further, the rate of orange color in the second game run was five times as much as that in the first game run. These facts indicate that players gradually recognized the wise utilization of the commons and avoided selfish exploitation. They gradually became cooperative. During the conference times, the players discussed how to play in the future rounds. Their opinion gradually became constructive. The 4th conference time of the second game run was the most remarkable one. A player proposed the idea that one player should choose orange, and the others red. The players agreed that a player having the highest points should choose orange and the others red. After this conference time, almost all of the players obeyed this agreement. (The player with the lowest total points was an exception, he chose green continuously).

The second experiment was carried out in the same room on the afternoon of February 8, 1984. Six 3rd year students of the university were the players in this game, with one of the authors as the game director. He decided to run the game in which the way of game playing (making total points public or not) was determined by agreement among the players involved in the game. Two games were carried out. In the first game run, the total points of the players were made public only between the second and third conference times. The second game, however, was played making total gains public in all the rounds.

Figures 22 to 25 present the results of the two game runs. The total points of the players in the second game run are slightly higher than those in the first game run. The rates of red and orange color in the second game run were higher than those in the first game run. The rate of green color decreased in the second game run. These gaming results also indicate the educational effects of this microcomputer gaming system. However, in this experiment a constructive opinion, that appeared in the first experiment, did not appear, probably because the 3rd year students did not understand the game so well.

After the experiments, almost all of the players stated that in their opinion this microcomputer gaming system was very helpful in learning about common problems, and also very interesting. However, some players complained that the game is rather monotonous, and could be modified.

3.4. A Trial to make the Microcomputer Game much more Interesting

We have described the Microcomputer Gaming System which is a modified version of the original Commons Game by Powers *et al.* (1980). Although this microcomputer gaming system gives us a valuable chance to consider the commons, we did find that, during the gaming experiments, some players did lose interest, in the middle of the game playing, because it is comparatively monotonous.

We are now making a new microcomputer gaming system that will improve the previous one. In the following, we will explain our efforts to make the game much more interesting.

1) In order to make the game playing much more exciting, we set up "Information Time" and "Vote Stage"

a. *Information Time:* After every six rounds the players have "Information Time". In this round they get information about the other player's strategies. If a player does not like his strategies being obtained by the other players he must pay more points than the points paid by all the players who want to get information concerning him. Figures 26 and 27 describe the graphic displays the microcomputer screen obtains at "Information Time".

b. *Vote Stage:* If the environmental level is below -2, the microcomputer screen presents a graphic display, see Figure 28. This figure gives the players all the information concerning the numbers of the cards they have selected during the game playing. Using this information, each player decides on two players whom he considers to be most responsible for the decline of the commons. He writes the names on the paper provided by the game director. After collecting all the papers, the game director inputs this data from the microcomputer keyboard. If a player is accused by more than 4 players, his total points are decreased to 0.7 × (his total points).

2) When players do not know each other communications have not been done successfully during the conference time. In the new game, a chairman is selected, randomly, by the microcomputer, in order to stimulate discussions among all of the players (Figure 29).

3) In order to allow the game playing to become much more dynamic and realistic, the number of red cards is limited to 6 in between conference times. (There are 8 rounds in between conference times).

4) In the original commons game, green players receive a penalty − 20 points when some player selects a black card. In the new game, penalty value P is determined by the following equation that depends upon the state of the commons.

$P = -\max(20, G/3)$, where G is the point that green players can reach when nobody selects a black card.

5) In order to promote "Orange Card" and "Black Card", some changes in the total points would be very reasonable, when the state of the commons improves (say, better than 2). For example we could consider the following changes.

If the sum of the numbers of orange cards and black cards is 5,

New Total Point = 1.2 × (Present Total Point)

If the sum of the numbers of orange cards and black cards is 6,

New Total Point = 1.25 × (Present Total Point)

If the sum of the numbers of orange cards and black cards is 7,

New Total Point = 1.3 × (Present Total Point)

If the sum of the numbers of orange cards and black cards is larger than 8,

New Total Point = 1.4 × (Present Total Point)

4. Concluding Remarks

We have described two Microcomputer-Based Games. We can enumerate several advantages for the microcomputer gaming system.

(1) Since the microcomputer calculates fast, players can enjoy game playing without a time delay.

(2) Players can grasp a vivid feature of the commons through a beautiful color graphic display. It may help players to concentrate on the game

playing.

(3) A floppy disc can be obtained quite easily, and so the game can be played wherever a computer is available. Since the game is "user friendly", even people with little knowledge of computers can become players.

(4) The microcomputer can store various data in the game playing. Therefore, the game director, and/or players, can successfully utilize them in follow-up sessions. (The microcomputer color graphics can stimulate discussions about the game).

(5) A Line Printer provides the game director with all of the necessary information during game playing.

However, the de-merits of using the microcomputer are:

(1) Where the same type of microcomputer is not available, the program must be rewritten so that it can be used by other microcomputers.

(2) As the screen of the microcomputer is not large, players must sit close to the screen.

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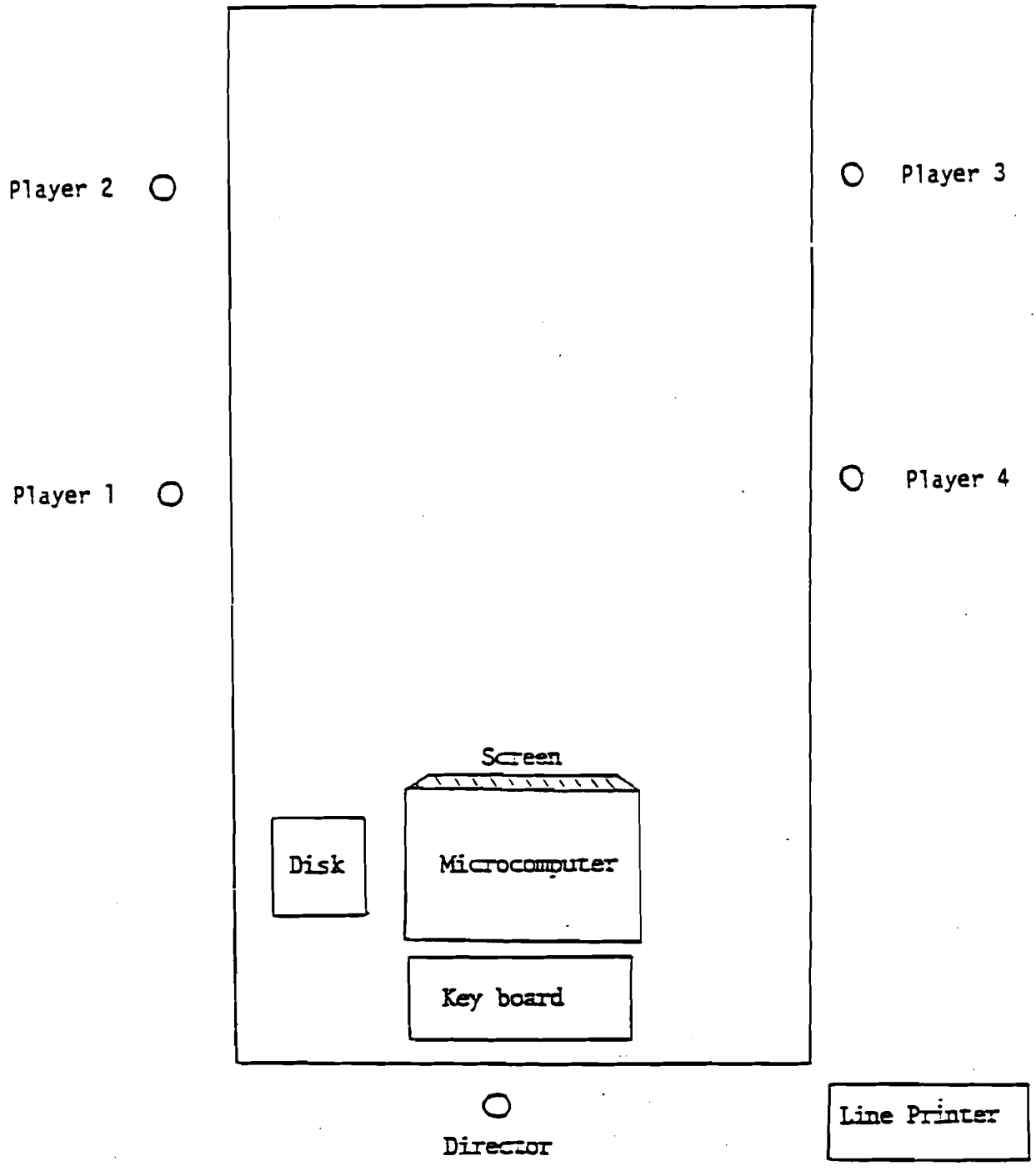
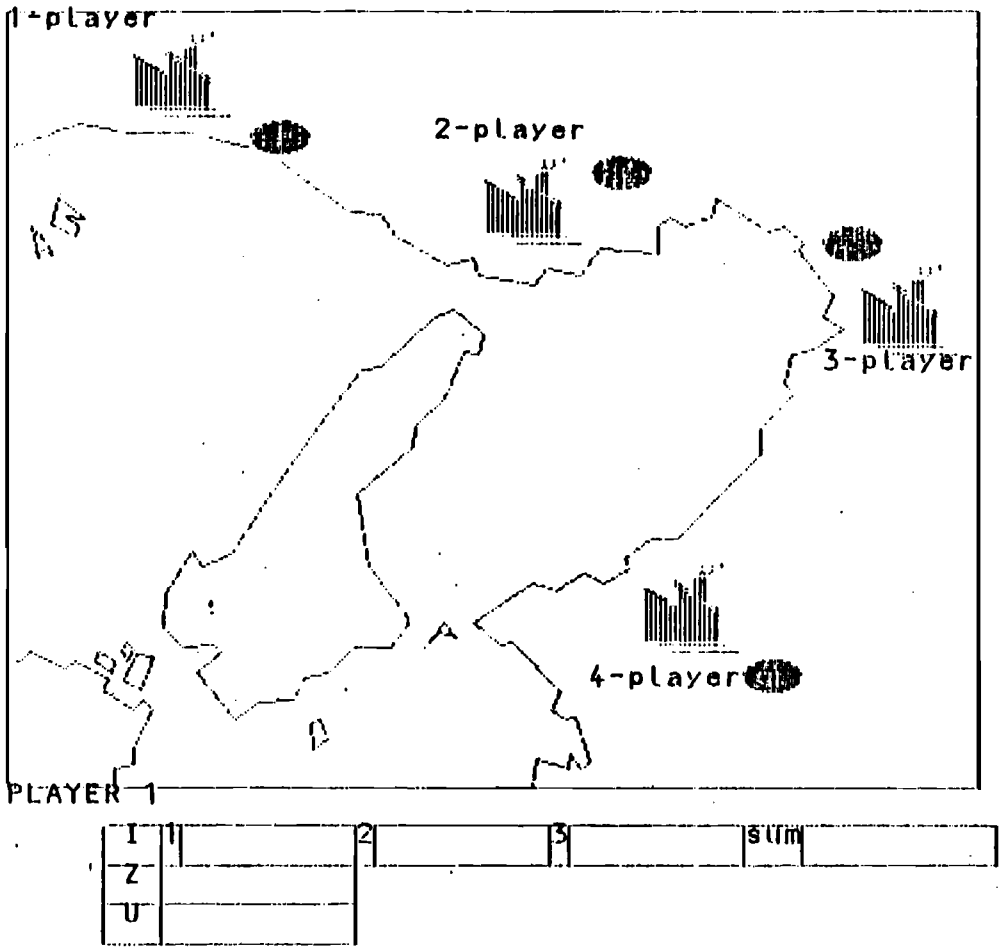


Figure 1 Model Layout in the Microcomputer Gaming



Clear Polluted
** State of the Sea **

*** Total money ***
COMPANY 1: 1000
COMPANY 2: 1000
COMPANY 3: 1000
COMPANY 4: 1000

Business Forecasting;
Very Bad

(Probability: 38%)

*** YEAR *** 1

Figure 2 A Graphic Display Which Appears on the Microcomputer Screen in the Initial Round

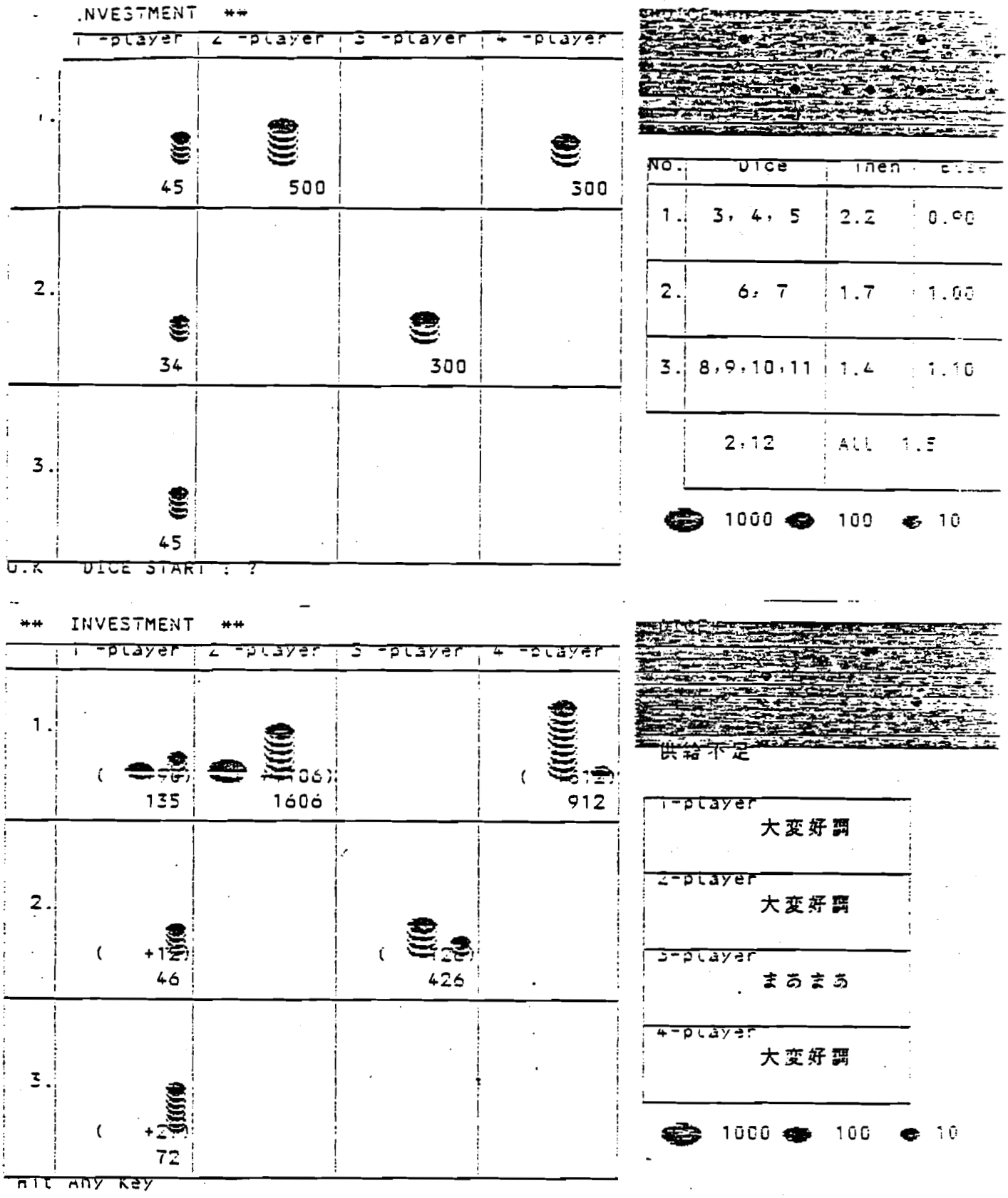
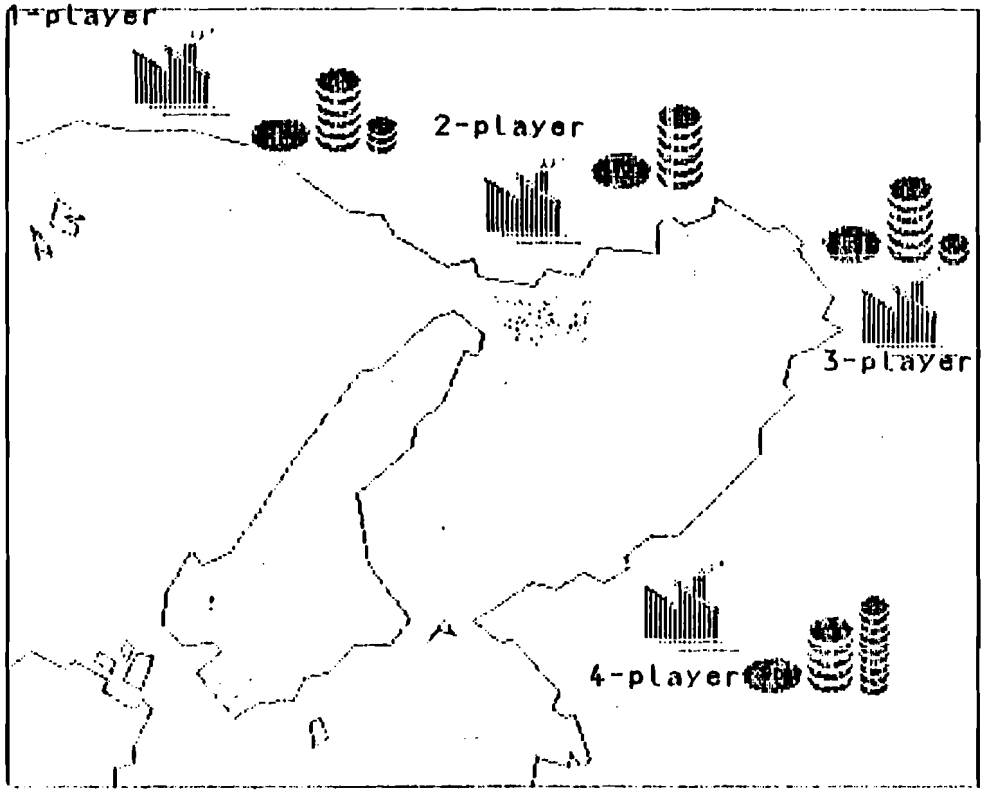


Figure 3 The Amount of Money Invested on the Three Chemical Goods and the Profits



Clear Polluted
** State of the Sea **

*** Total money ***
COMPANY 1: 1637
COMPANY 2: 1600
COMPANY 3: 1625
COMPANY 4: 1599

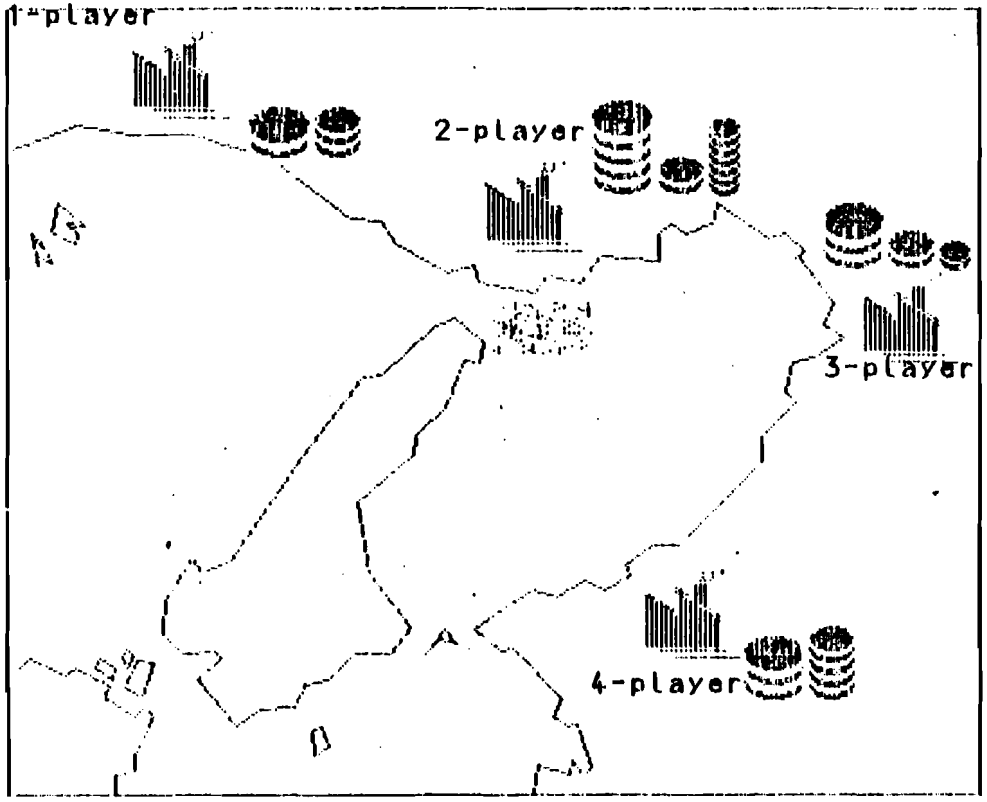
Business Forecasting;
Average

(Probability: 54%)

*** YEAR *** 4

Redtide appears in the sea near the factories of the Second-player.

Figure 4 A Graphic Display Which Appeared on the Microcomputer Screen in the 4th round



Clear Polluted
** State of the Sea **

*** Total money ***
COMPANY 1: 2307
COMPANY 2: 4644
COMPANY 3: 3223
COMPANY 4: 3500

Business Forecasting;
Very Good

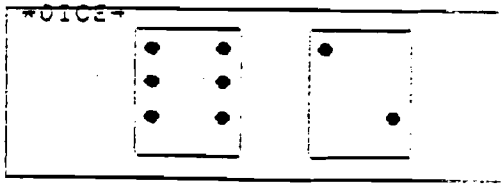
(Probability: 50%)

*** YEAR *** 7

Redtide appears in the sea near the factories of the Second-player.
Penalty 630

Figure 5 A Graphic Display Which Appeared on the Microcomputer Screen in the 7th Round

ce Fourth-player has contributed a lot to
- e decontamination of the environmental,
ie goverment gives him the following reward.



REWARD ・・・・・・・・ 100

Fourth-player could increase this reward by using two dices.

（最低０．１倍 -- 最高３．６倍）

Do you want to throw dice? (yes ・・・ Y-KEY)? y

得た金額 = 100 * 6 * 2 / 10

= 120

Hit Any Key

Figure 6 This Figure Indicates That the Microcomputer Has Chosen the 4th Player as the One Who Has Most Contributed to the Decontamination of the Sea

Fishery Group Demand Compensation for the Serious Damage in the Sea.

If you think being responsible for the damage,

you must pay some amount of money.

1 - Player ? 0

2 - Player ? 300

3 - Player ? 200

4 - Player ? 400

OK? (yes・・・Y/no・・・N)?

Figure 7 This Figure Indicates that Each Player Must Decide How Much Money He Should Pay for the Serious Damage in the Sea

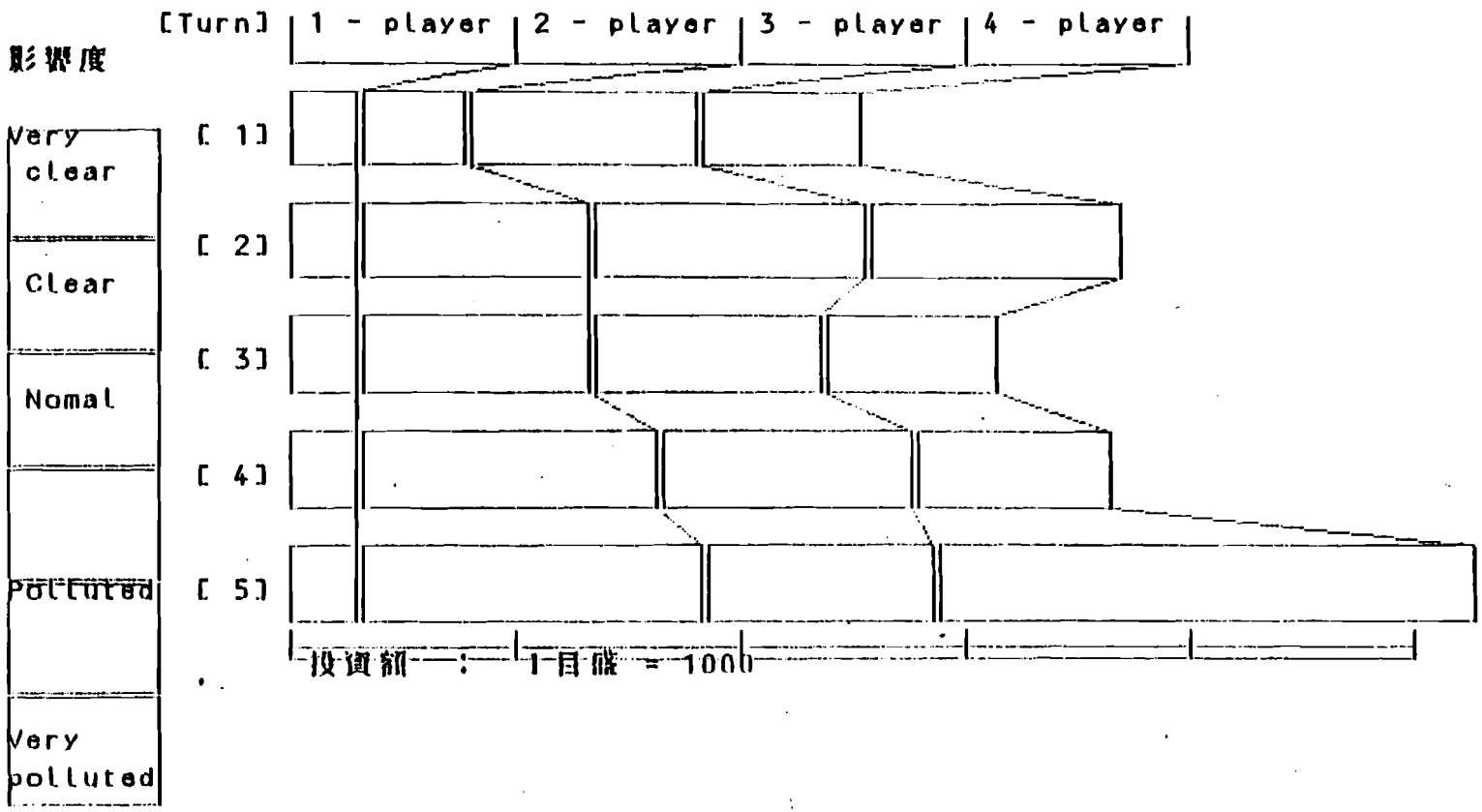


Figure 8 Informations Concerning How Players Have Influenced the Environmental Contamination During the Past 5 years

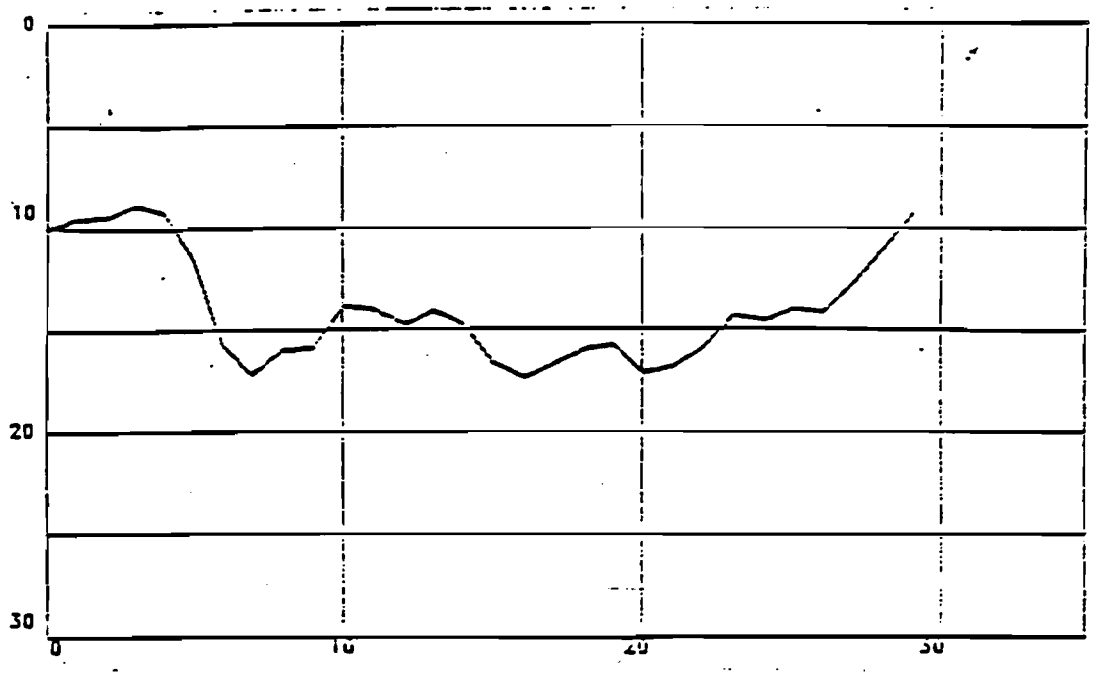


Figure 9 The Changes of the Environmental State at the Innerland Sea in the First Game Run

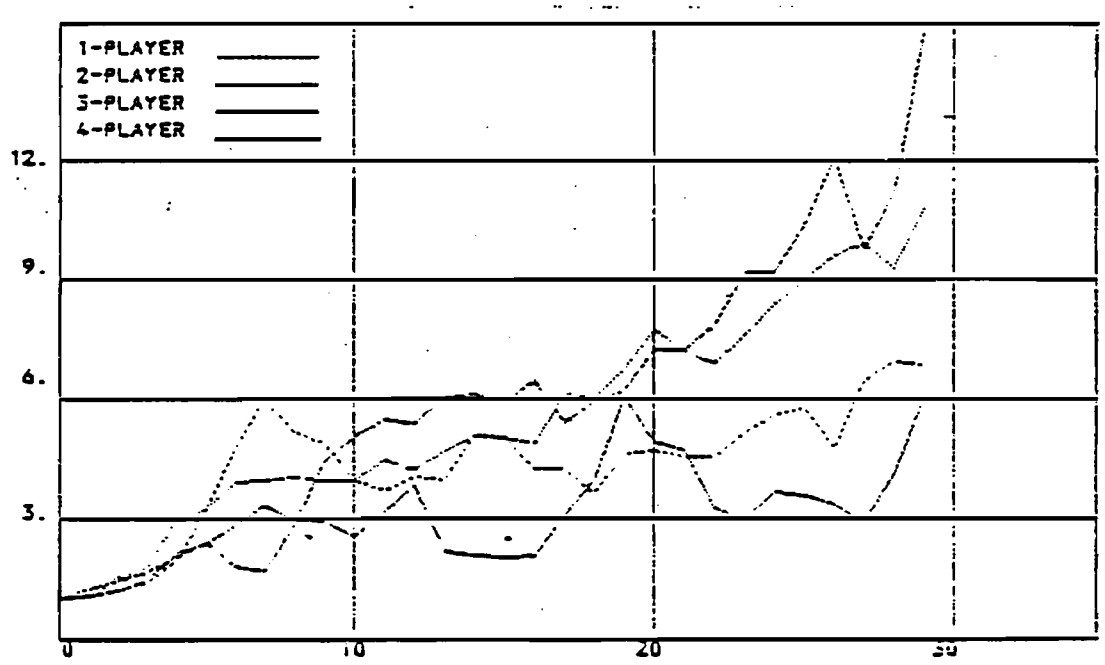


Figure 10 The Changes of the Gains in the First Game Run

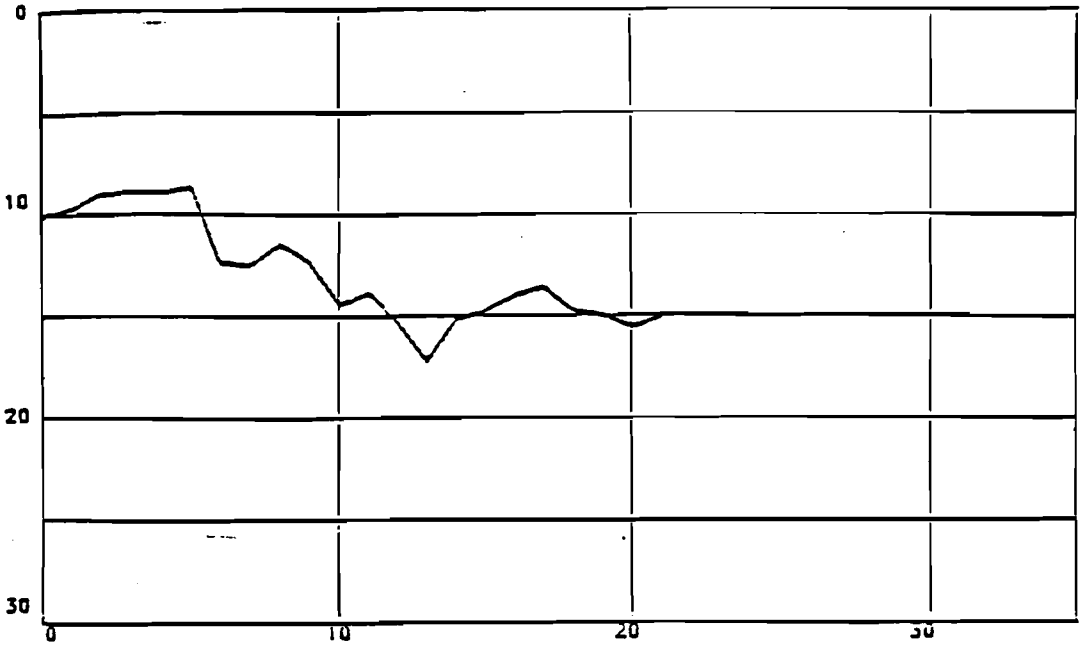


Figure 11 The Changes of the Environmental State in the Second Game Run

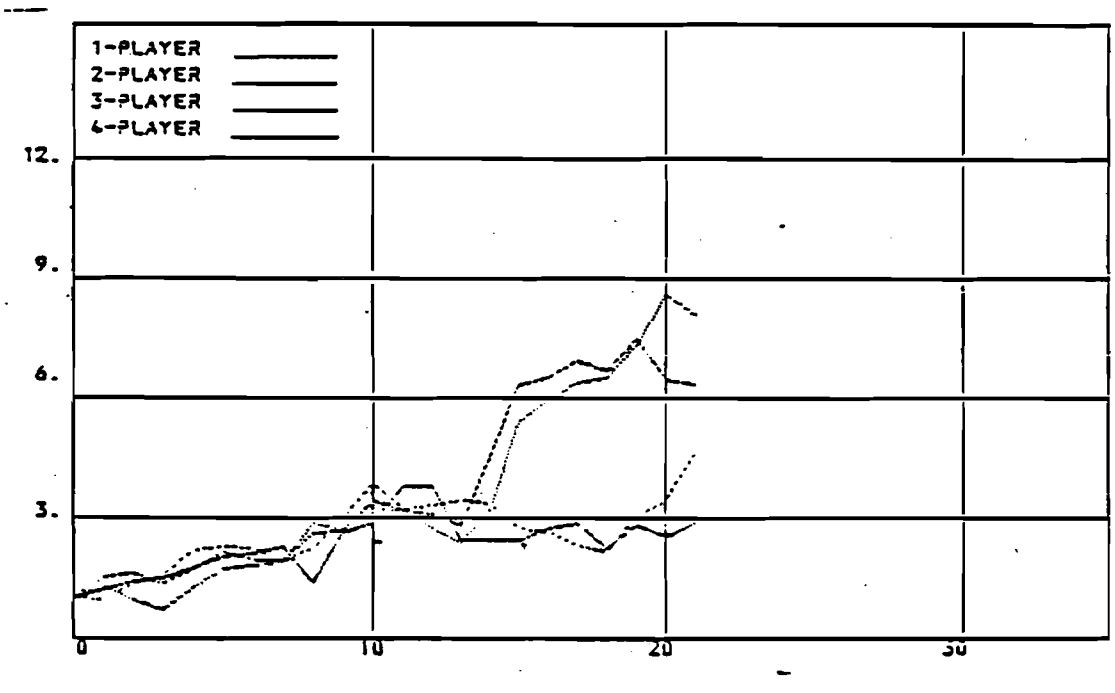


Figure 12 The Changes of the Gains in the Second Game Run

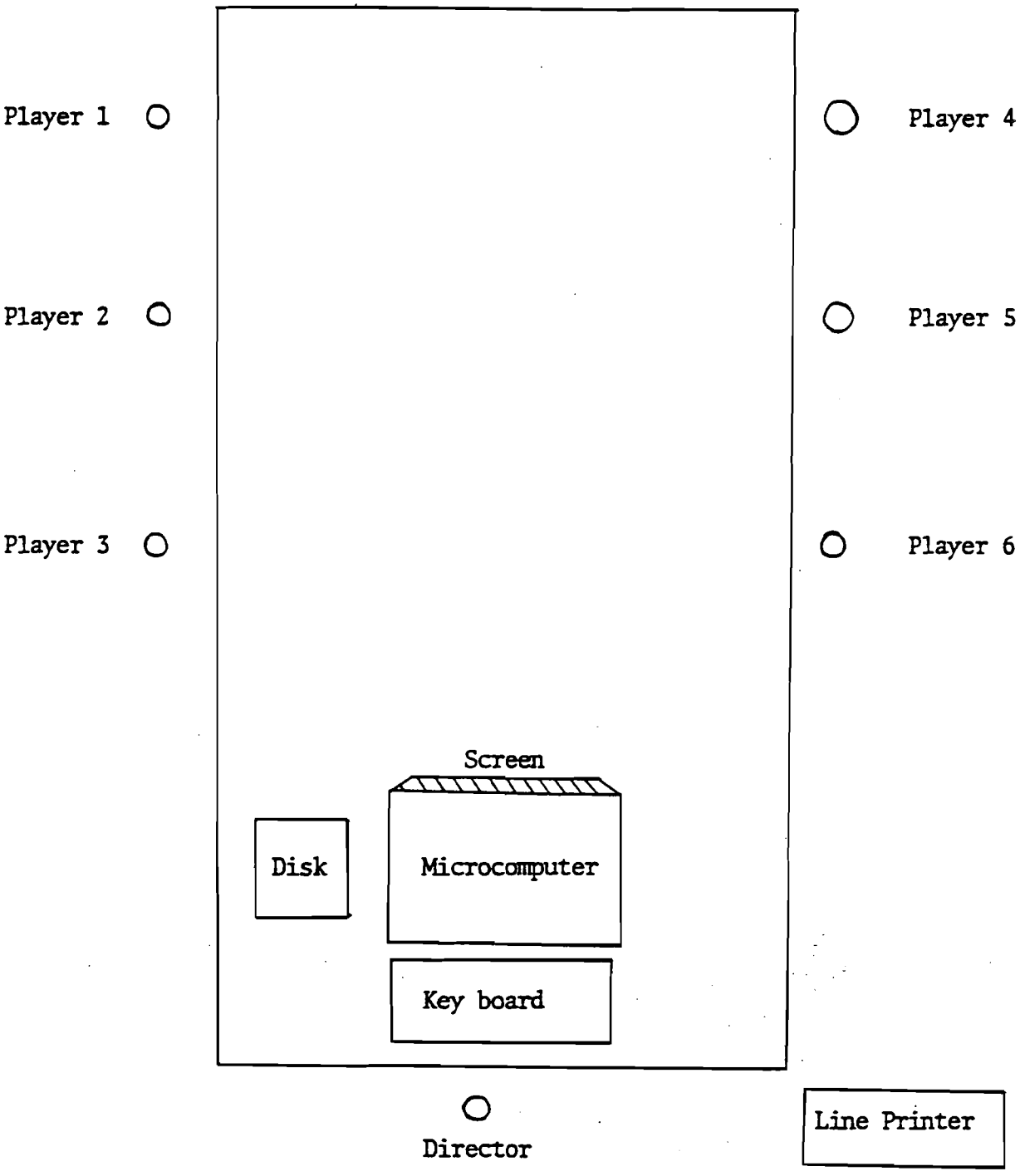
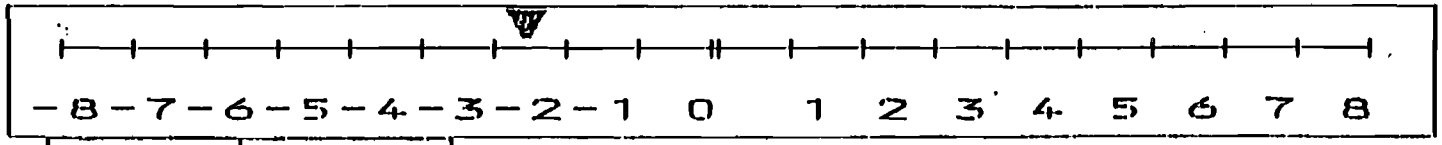


Figure 13 Model Layout in the Microcomputer Gaming



Red	Green
0	46
13	48
15	50
17	52
19	54
21	56
23	0

*RESULT OF LAST TRIAL

		POINT
GREEN	2	-20
RED	1	23
YELLOW	1	6
BLACK	1	-6
ORANGE	1	-6

Trial 6

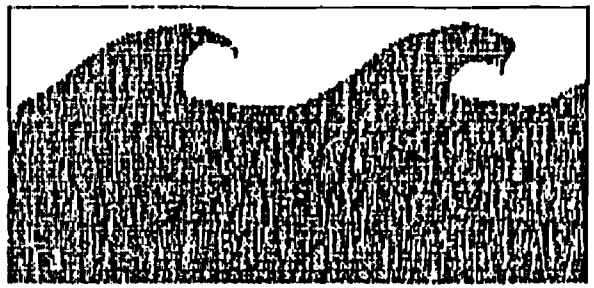


Figure 14 Display on the Microcomputer Screen during the Game Playing

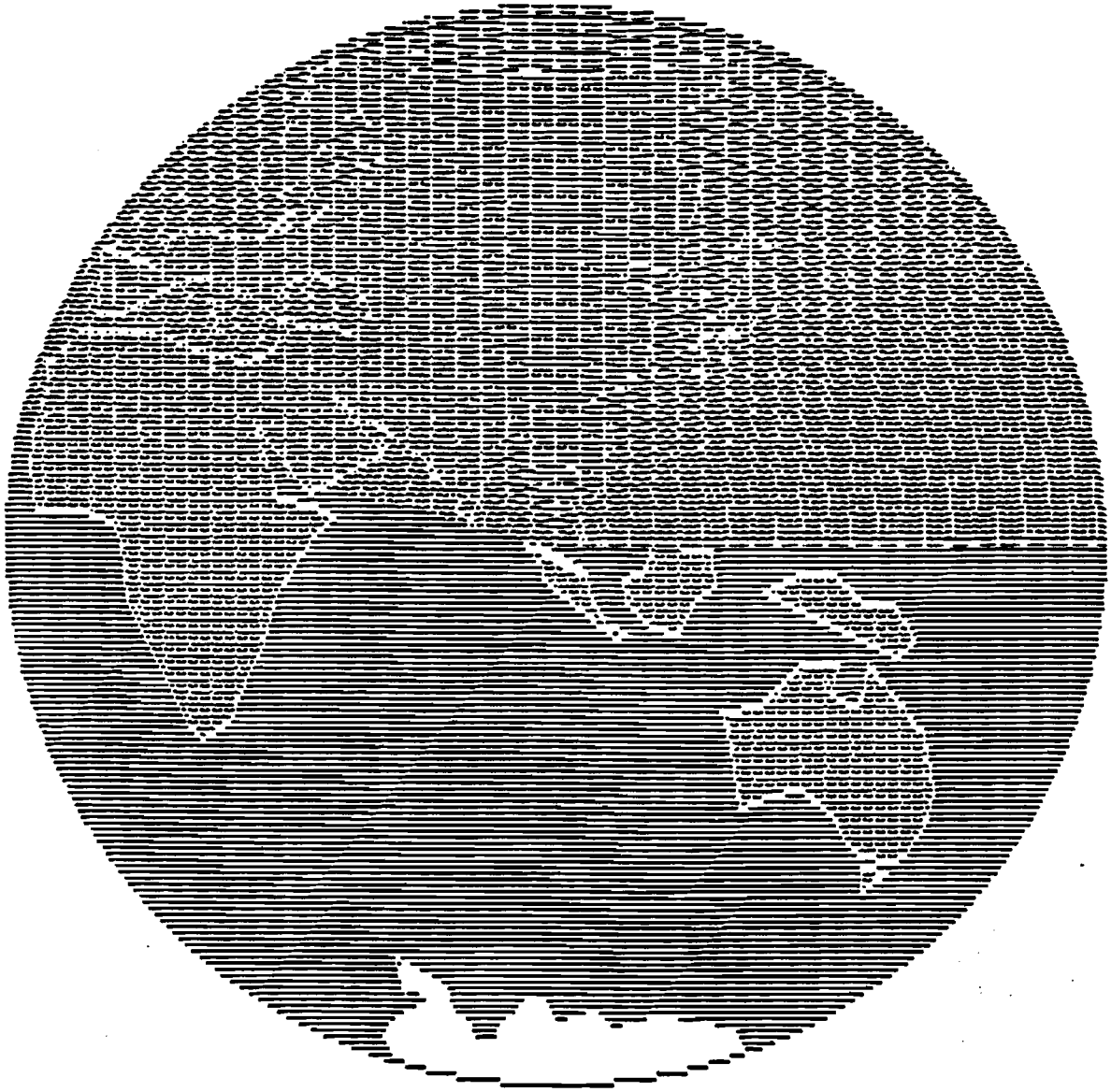


Figure 15 Display on the Microcomputer Screen during the Conference Time

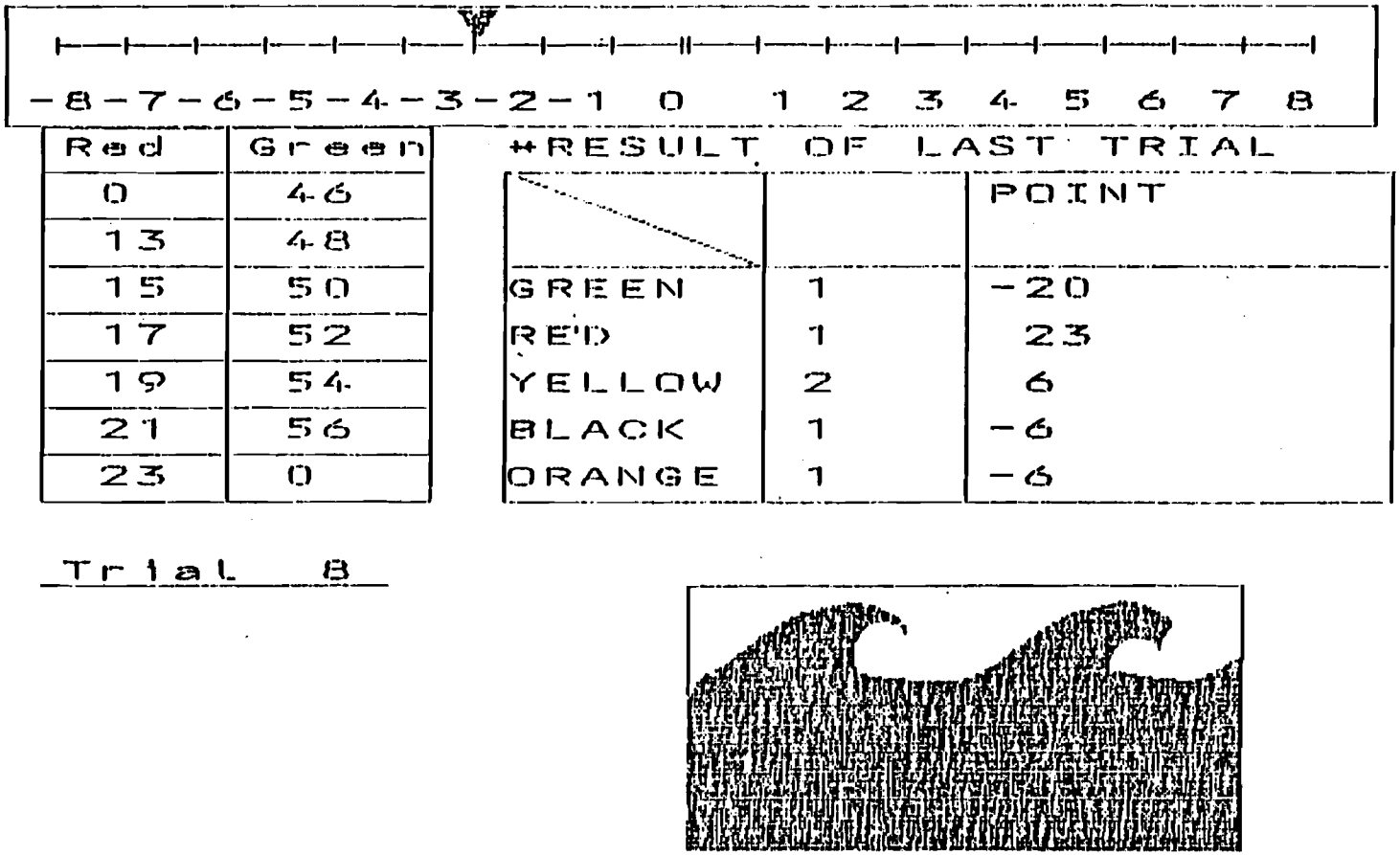
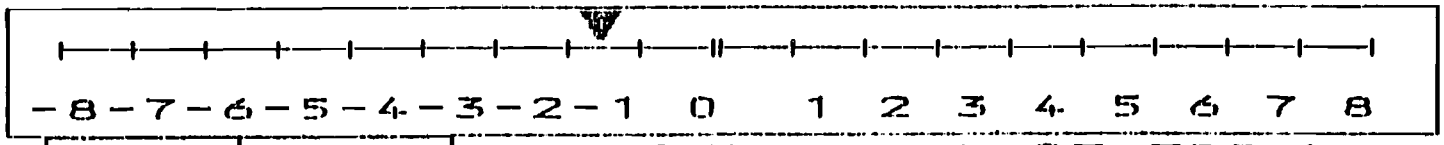


Figure 16 Display on the Microcomputer Screen during the Game playing in Which Total Points of the Players Are Kept Secret



Red	Green
0	70
25	72
27	74
29	76
31	78
33	80
35	0

*RESULT OF LAST TRIAL

	Points	Total Point	Color
1	-20	281	G
2	-20	330	G
3	23	305	R
4	6	264	Y
5	-6	336	O
6	-6	318	B

Trial 7

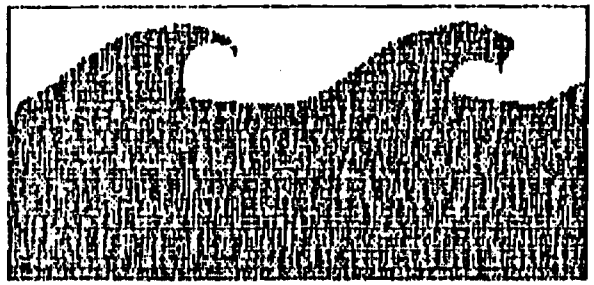


Figure 17 Display on the Microcomputer Screen during the Game Playing in Which Total Points of the Players Are Made Public

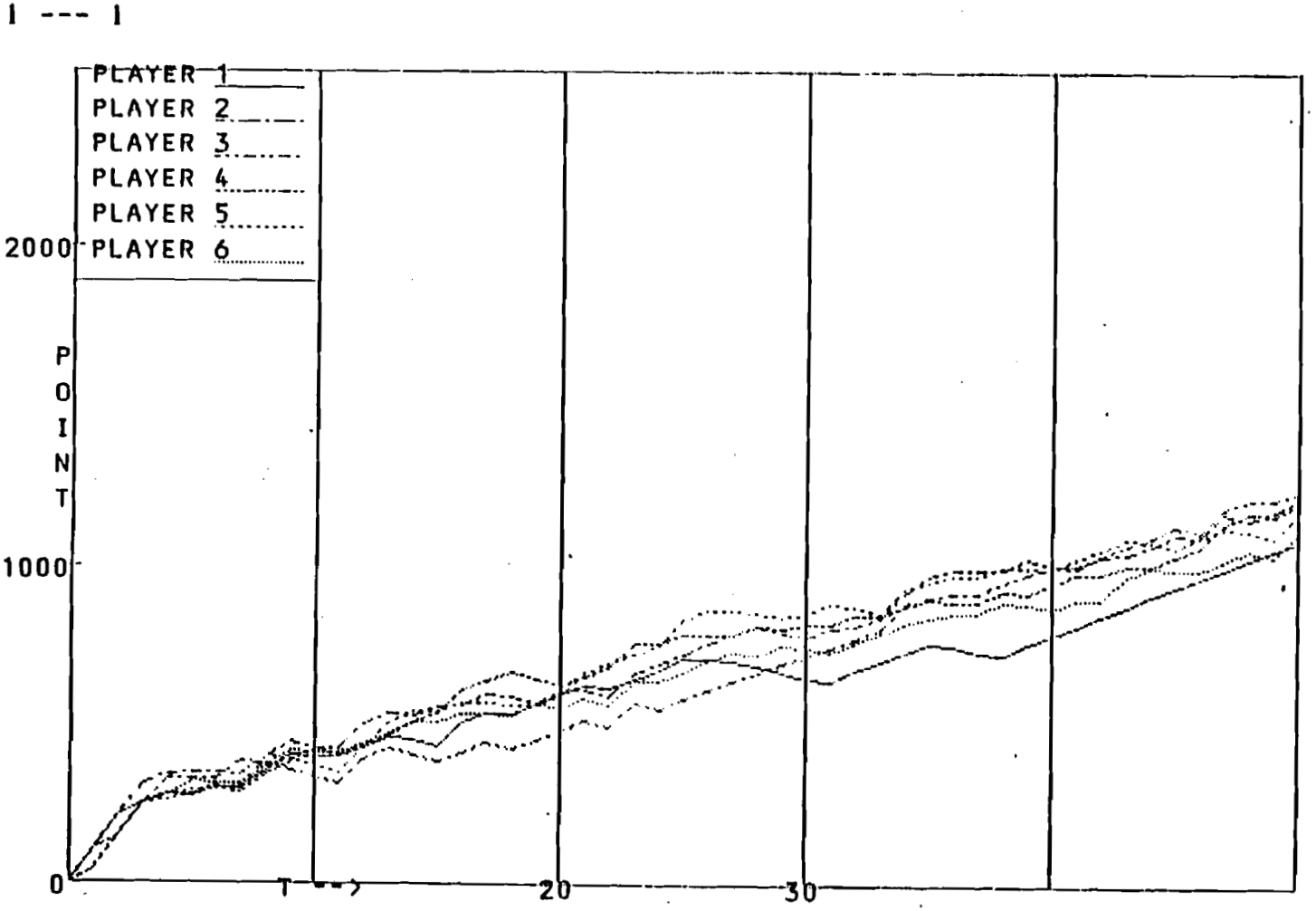


Figure 18 Changes of the Total Points of Each Player in the First Game Run of the First Experiment

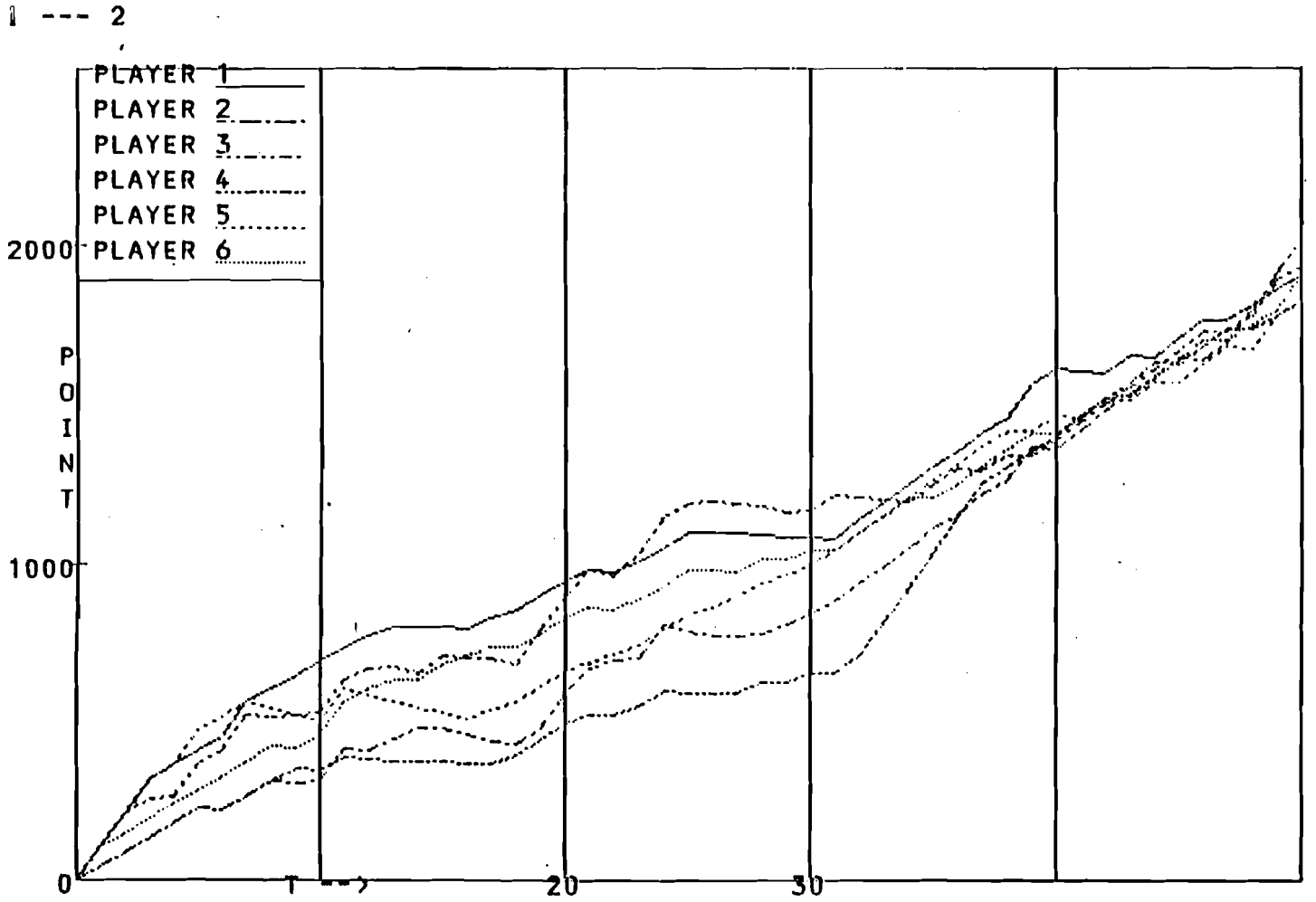


Figure 19 Changes of the Total Points of Each Player in the Second Game Run of the First Experiment

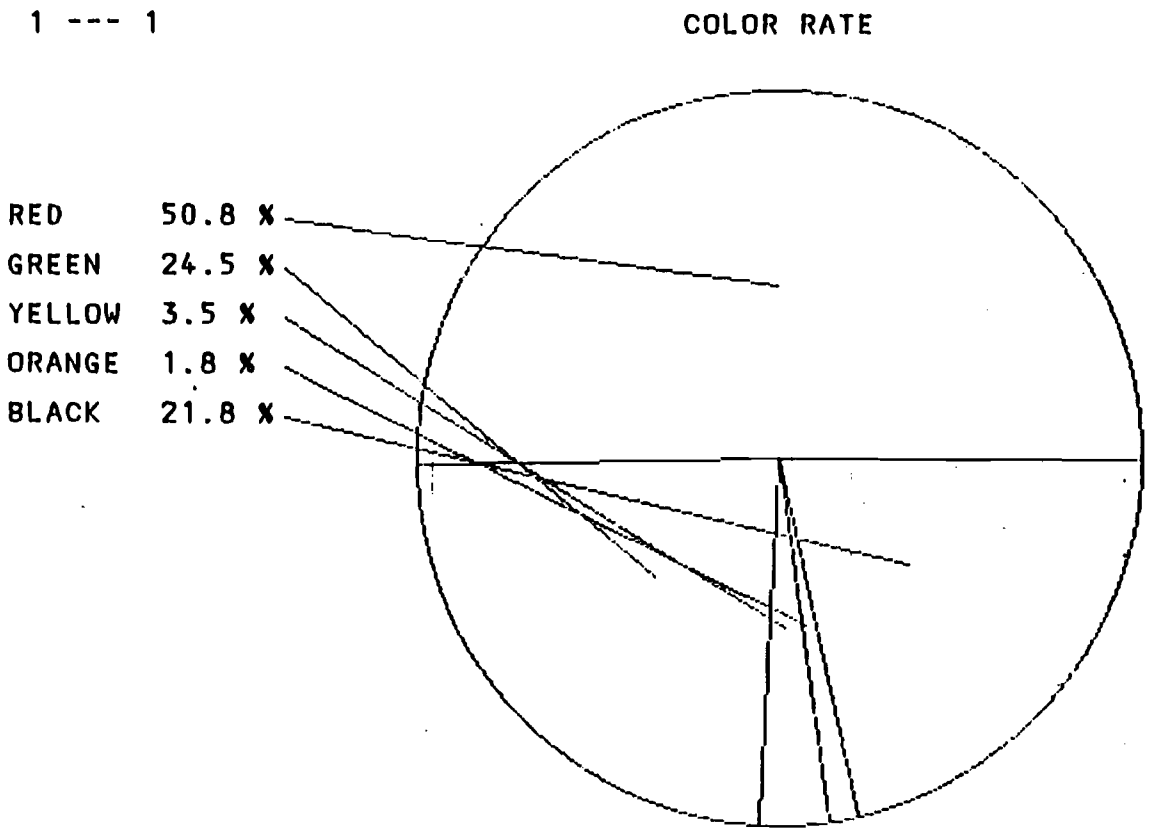


Figure 20 The Colour Rate Which Was Used in the First Game Run of the First Experiment

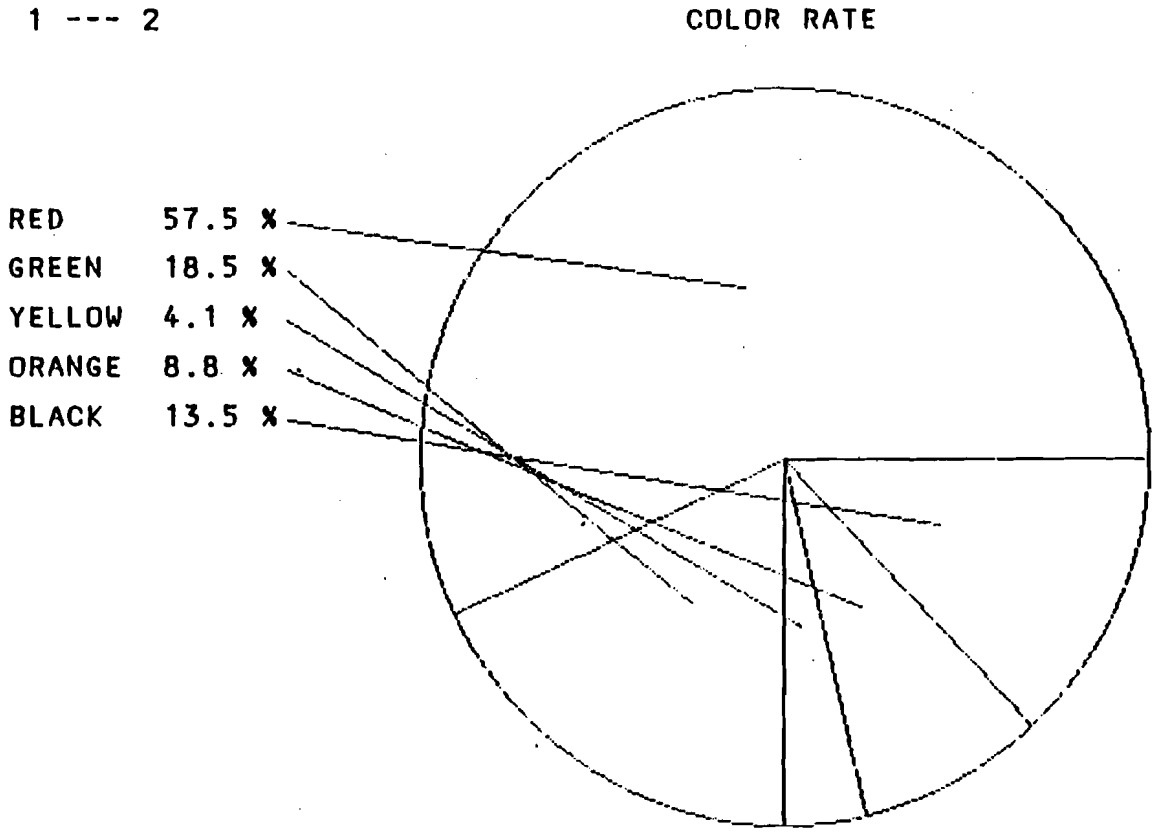


Figure 21 The Colour Rate Which Was Used in the Second Game Run of the First Experiment

2 --- 1

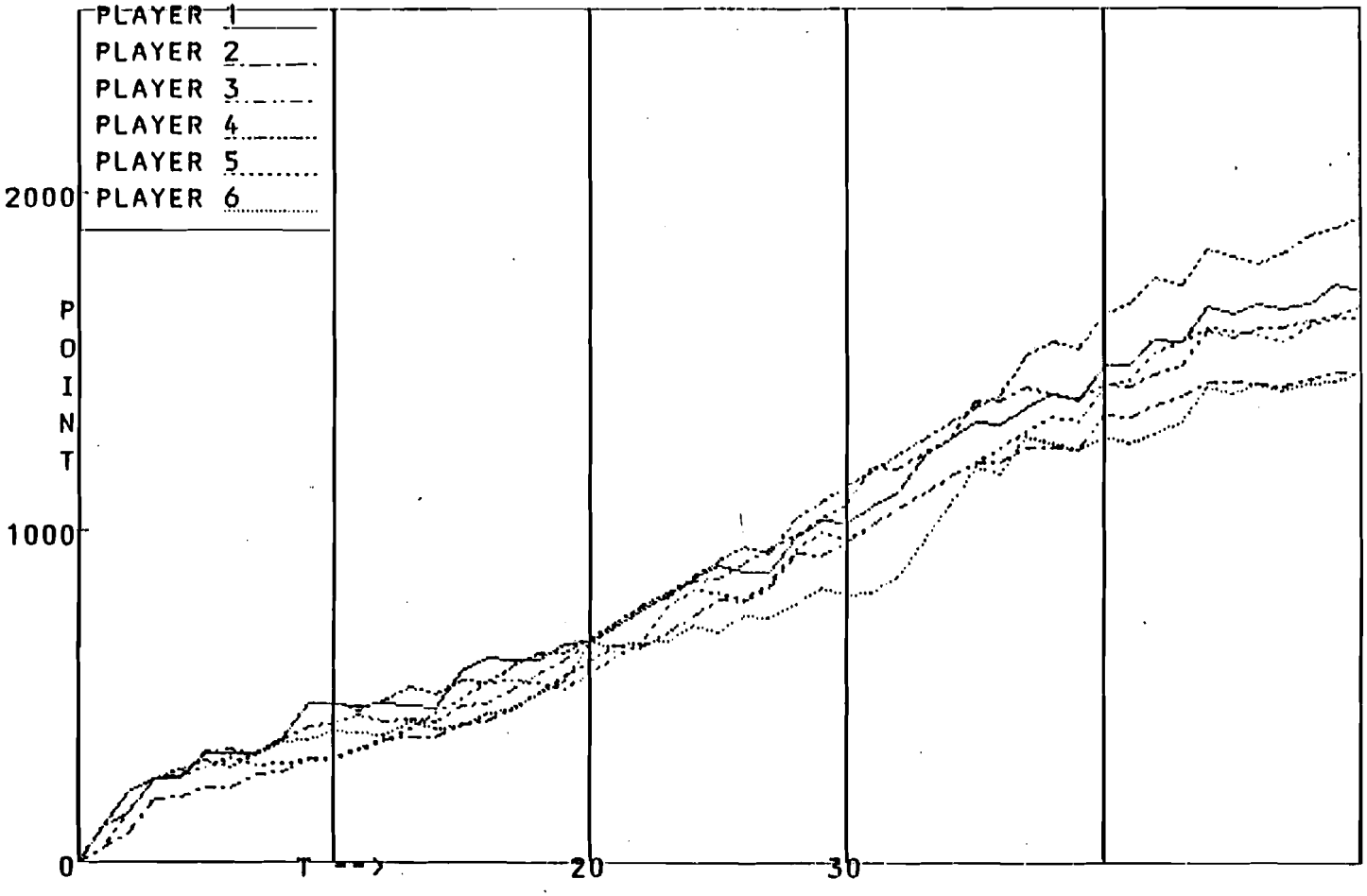


Figure 22 Changes of the Total Points of Each Player in the First Game Run of the Second Experiment

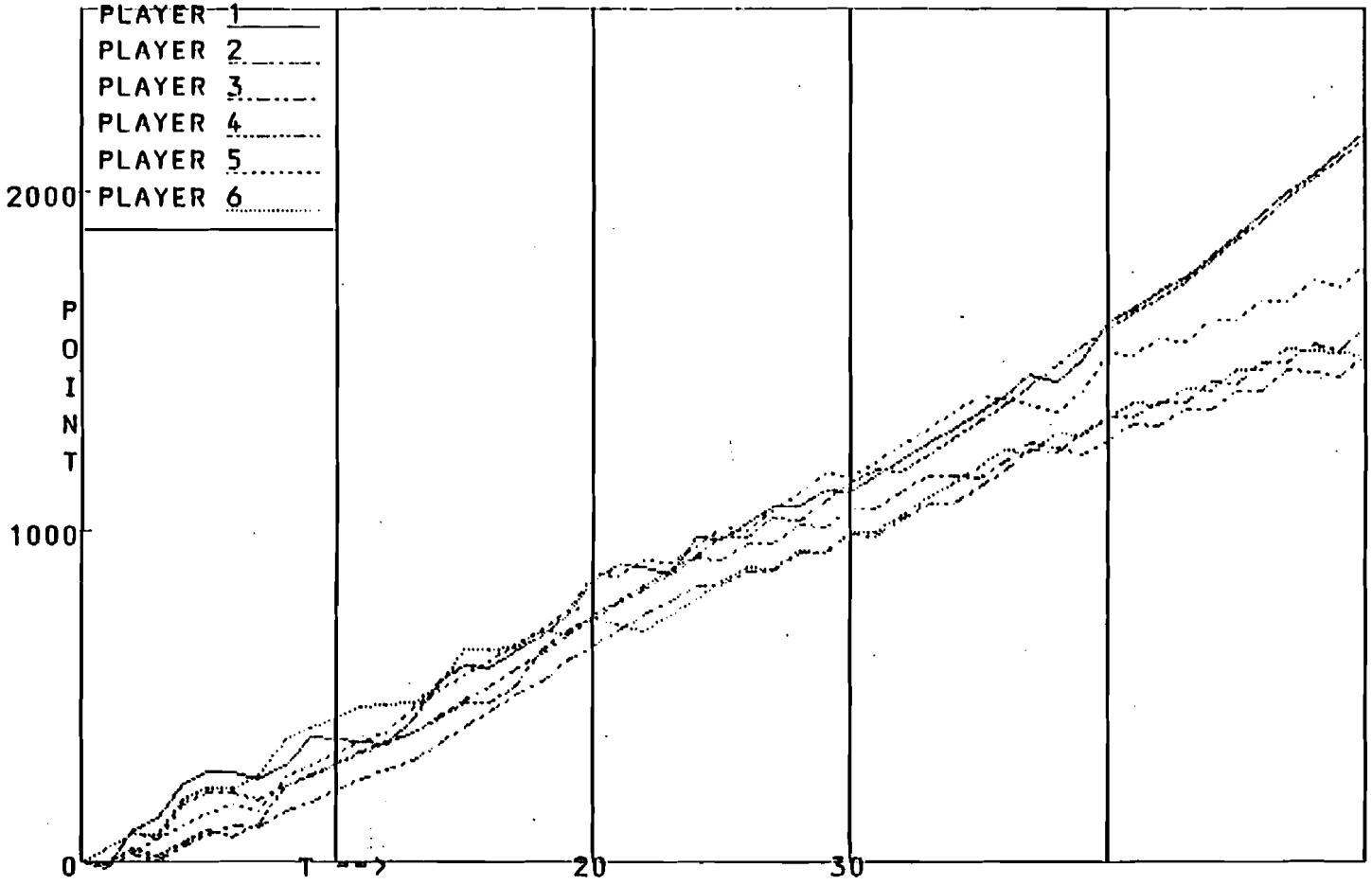


Figure 23 Changes of the Total Points of Each Player in the Second Game Run of the Second Experiment

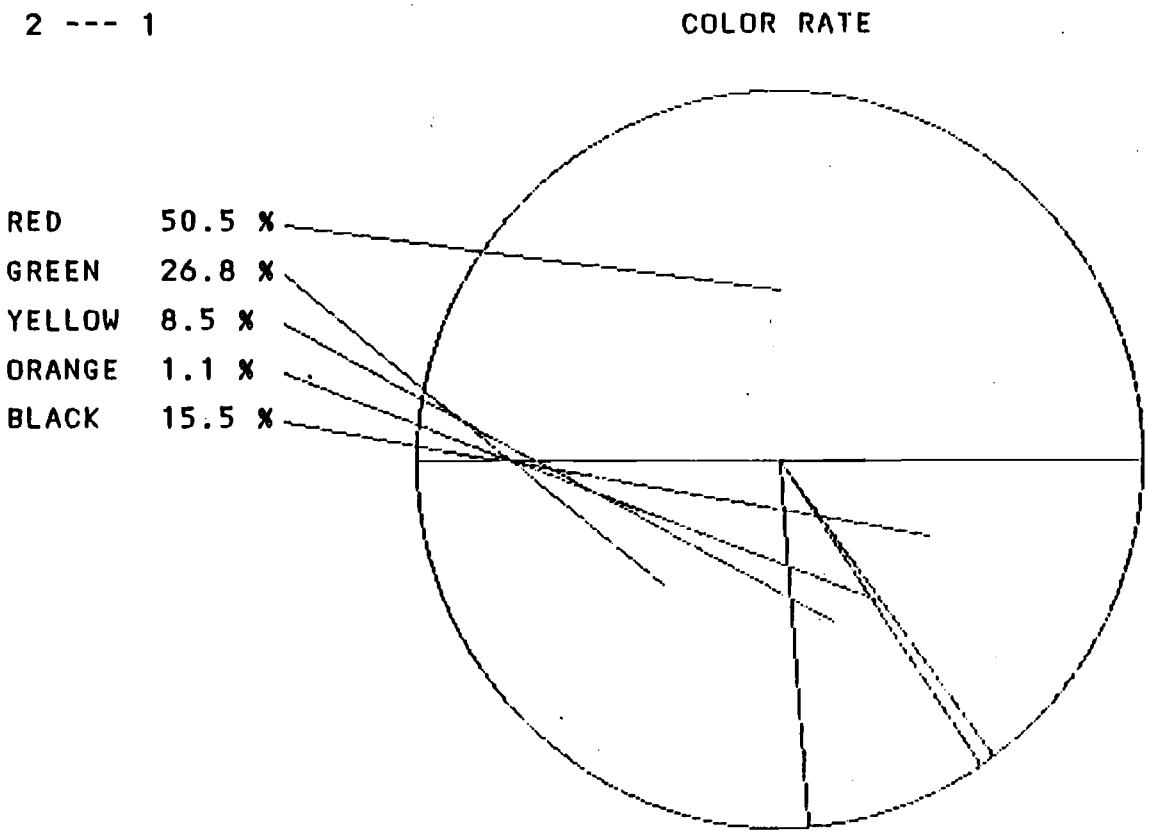


Figure 24 The Colour Rate Which Was Used in the First Game Run of the Second Experiment

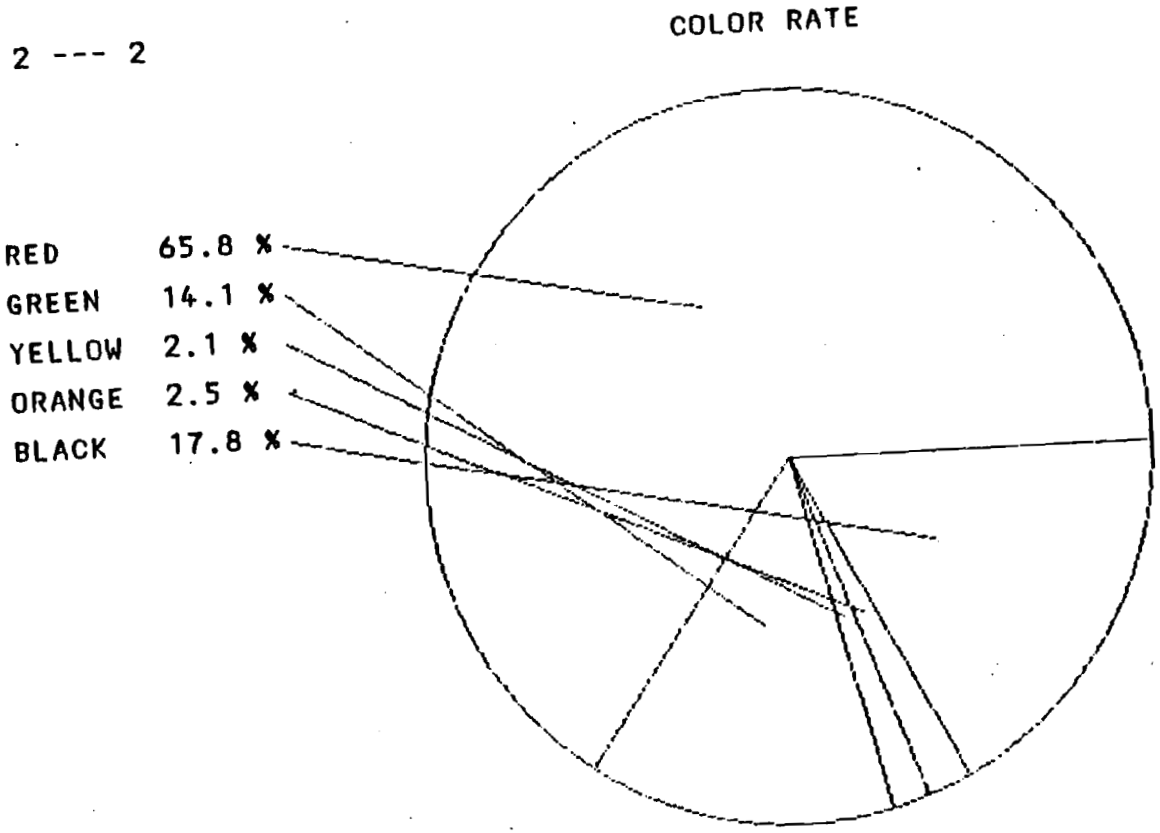


Figure 25 The Colour Rate Which Was Used In the Second Game Run of the Second Experiment

***** INFORMATION TIME *****

8 - TURN

PLAYER	NEEDED INFORMATION	OBTAIN INF.	CAN'T OBTAIN INF.
1			

PLAYER 1

WHICH PLAYER'S INFORMATION DO YOU WANT ? (1-6,0---NO)

HOW MUCH DO YOU PAY FOR INFORMATION ??

Figure 26 Display of the Microcomputer Screen at the Information Time

***** INFORMATION TIME *****

8 - TURN

PLAYER	NEEDED INFORMATION	OBTAIN INF.	CAN'T OBTAIN INF.
1	2.3.4.	2.3.4.	
2	1.3.4.5.	1.3.4.5.	
3	1.2.4.5.	1.2.5.	4.
4	1.2.3.6.	1.2.	3.6.
5	1.	1.	
6	1.2.3.4.5.	1.2.4.5.	3.

HIT ANY KEY?

Figure 27 Display of the Microcomputer Screen at the Information Time

PLAYER	1	2	3	4	5	6
RED	0	1	0	1	1	1
GREEN	4	5	5	5	5	6
BLACK	3	0	1	0	1	0
YELLOW	0	1	2	1	0	1
ORANGE	1	1	0	1	1	0

Figure 28 Display of the Microcomputer Screen at the Vote Stage

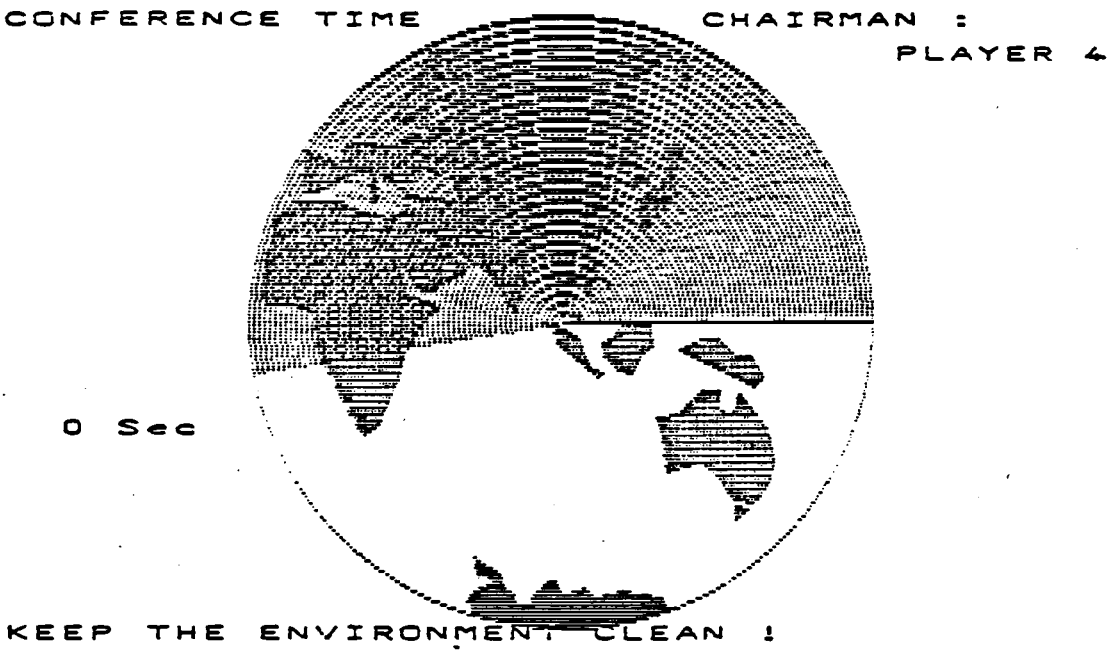


Figure 29 Graphic Display of the Microcomputer Screen at the Conference Time

PLAYER-1

	1	2	3	4	5	6	7	8	9	10
GREEN	3	1	5	2	2	4	2	3	1	4
RED	1	5	1	3	1	2	4	2	2	5
YELLOW	4	2	3	1	3	3	1	5	3	1
ORANGE	2	4	2	5	5	1	3	4	4	3
BLACK	5	3	4	4	4	5	5	1	5	2

Table 1 Code Matrix of Player 1

PLAYER-2

	1	2	3	4	5	6	7	8	9	10
GREEN	3	2	3	1	1	3	2	5	1	2
RED	4	1	5	3	2	4	1	4	2	3
YELLOW	1	4	4	2	3	1	4	1	3	1
ORANGE	5	3	2	4	5	2	3	2	4	5
BLACK	2	5	1	5	4	5	5	3	5	4

Table 2 Code Matrix of Player 2

PLAYER-3

	1	2	3	4	5	6	7	8	9	10
GREEN	1	2	3	1	2	3	2	4	5	1
RED	5	1	2	2	1	2	1	5	4	2
YELLOW	4	5	1	3	3	4	3	2	1	5
ORANGE	3	4	4	5	4	1	4	1	3	4
BLACK	2	3	5	4	5	5	5	3	2	3

Table 3 Code Matrix of Player 3

PLAYER-4

	1	2	3	4	5	6	7	8	9	10
GREEN	3	1	2	5	3	1	5	2	1	2
RED	1	2	1	4	2	2	1	3	5	1
YELLOW	4	5	5	2	4	3	2	1	3	3
ORANGE	5	3	3	1	5	4	4	5	4	5
BLACK	2	4	4	3	1	5	3	4	2	4

Table 4 Code Matrix of Player 4

PLAYER-5

	1	2	3	4	5	6	7	8	9	10
GREEN	2	1	5	1	2	5	4	1	2	4
RED	3	2	4	5	1	1	5	2	1	5
YELLOW	1	3	3	2	3	4	1	3	4	1
ORANGE	4	5	2	4	4	2	3	5	3	2
BLACK	5	4	1	3	5	3	2	4	5	3

Table 5 Code Matrix of Player 5

PLAYER-6

	1	2	3	4	5	6	7	8	9	10
GREEN	2	5	5	1	5	1	3	2	1	3
RED	3	1	2	3	4	2	4	1	2	2
YELLOW	1	2	1	2	3	5	2	3	3	1
ORANGE	4	3	4	5	2	4	1	5	4	5
BLACK	5	4	3	4	1	3	5	4	5	4

Table 6 Code Matrix of Player 6

PLAYER-1	1 2 3 4 5 6 7 8 9 10	PLAYER-2	1 2 3 4 5 6 7 8 9 10
1	R G R Y R O Y B G Y	1	Y R B G G Y R Y G Y
2	O Y O G G R G R R B	2	B G O Y R O G O R G
3	G B Y R Y Y O G Y O	3	G O G R Y G O B Y R
4	Y O B B B G R O O G	4	R Y Y O B R Y R O B
5	B R G O O B B Y B R	5	O B R B O B B G B O
PLAYER-3	1 2 3 4 5 6 7 8 9 10	PLAYER-4	1 2 3 4 5 6 7 8 9 10
1	G R Y G R O R O Y G	1	R G R O B G R Y G R
2	B G R R G R G Y B R	2	B R G Y R R Y G B G
3	O B G Y Y G Y B O B	3	G O O B G Y B R Y Y
4	Y O O B O Y O G R O	4	Y B B R Y O O B O B
5	R Y B O B B B R G Y	5	O Y Y G O B G O R O
PLAYER-5	1 2 3 4 5 6 7 8 9 10	PLAYER-6	1 2 3 4 5 6 7 8 9 10
1	Y G B G R R Y G R Y	1	Y R Y G B G O R G Y
2	G R O Y G O B R G O	2	G Y R Y O R Y G R R
3	R Y Y B Y B O Y O B	3	R O B R Y B G Y Y G
4	O B R O O Y G B Y G	4	O B O B R O R B O B
5	B O G R B G R O B R	5	B G G O G Y B O B O

Table 7 Code Matrix of the Game Director