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Ceramic Art, Its Sculptural Possibilities and Limitations: The Studio Experience

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Abstract

Ceramic Art and Sculpture are two sister disciplines that explore clay as a medium for creative visual dialogue. But unlike ceramic art which depends primarily on clay, sculpture exploits in addition other media such as metal of all types, wood, cement and all kinds of found objects which predispose the sculptor to limitless and varied creative possibilities. Some of these possibilities are lacking in ceramic art because of the nature of clay. Over dependent on clay tends to limit the creative potentials of ceramists. Ceramic art is faced with certain creative limitations which arise from the nature of material used, and which affect either positively or negatively the forms produced, firing techniques and methods of production. In other words, these factors which are inevitable control design in ceramic art. And considering the misconception cast on the creative potentials of the ceramist, it has become imperative to identify and document them in a more detailed form in order for people to appreciate the extent of their implications on the practice of ceramic art.

Keywords: Ceramic Art, Sculpture, Creative Possibilities, Creative Limitations

Introduction

Ceramic art happens to be one of the areas of the plastic art that lends itself to a lot of creative potentials. The availability and abundance of clay, the basic raw material for pottery making in almost every tribal culture, made many of the tribal cultures both in the past and present to adopt it as one major means of expression. Clay has been in use since the prehistoric era thus making pottery one of the oldest arts practiced by man.

However, the art of pottery has not been easy. Potters, even from the time of the primitive culture have suffered many difficulties arising from the nature of materials used (particularly clay), forms, firing techniques and production methods, which have always been discouraging. These factors, which are inherent in the ceramic art, tend to limit the creative potentials of the ceramist. Thus, the subject of design in ceramic art has remained static to some extent even in this age of experimentation, because clay, for instance, cannot be stretched beyond certain limits. For instance, there is a global receptivity of the new concept of "installation" in art as easily practiced in sculpture, but in ceramics this is practiced with difficulties imposed by the nature of clay. In a developing country like Nigeria where potters still depend on bodies that are predominantly clay, the production of ornamental wares as practiced in developed countries is difficult to exploit for this reason.

Nevertheless, while we strive to develop new techniques in spite of these difficulties, it is important to highlight some of the problems or factors that give rise to them so that we can appreciate the efforts being made by ceramists to remain afloat.

Nature of the Raw Material - Clay

The first problem that faces the ceramist arises from the nature of his raw material-clay. Clay is fundamental in the practice of ceramic art and it has remained so since the beginning of the art. No material on earth today has succeeded in replacing clay in the ease with which it can be shaped into objects of usefulness. This is made possible because of its inherent qualities that are not possessed by other materials of similar origin. For instance, rocks which are also derived from the earth's surface and which share almost the same chemical properties differ considerably from clay in their physical properties.

Unfortunately, some of these qualities (physical properties of clay) are counter-productive in the practice of the art. First, clay has the characteristic quality of yielding to pressure and taking any shape given to it when the pressure is removed. This is referred to as "plasticity" In other words, plasticity is "the property which allows the material to be deformed without cracking or breaking, under the influence of an applied force, and to retain its new shape when the deforming force is removed or reduced below a certain value"[1]. Ryan notes that "the problems of understanding and measuring plasticity have occupied much time of the research ceramist, but this most important and fundamental property, without which many present shaping methods would be impossible, is still not completely understood"[2].

Rhodes and Fraser in sharing the same view, however, note that a critical study under the electron microscope has revealed that the clay particles are in form of thin plates, hexagonal in shape (plate-shaped elongated in two dimensions),[3] When water is introduced, it is the plate-like shapes of the particles that enables them (particles) to slide easily over one another when pressure is applied and help retain their resultant positions when the pressure is removed thus aiding the formation of a clay mass or object. In contrast, it will be noted that earthy materials like finely ground sand, although will readily absorb water like clay at the surface of the particles, but since these particles are not plate-shaped, they cannot slide easily over one another and that is why sand has little or no plasticity.

Plasticity is an important character of clay, which marks it out from other materials. It means that if clay is not plastic enough it cannot be useful in ceramic production, because such clay cannot respond to shaping, especially by throwing and modeling. Therefore, there are certain degrees of plasticity that are desirable. Apart from the non-plastic nature of some clays, there are still some that are excessively plastic. These two extremities in the scale of the plastic property of clay affect design because of the problem arising from them, which lower the quality of the product. For instance, if clay is excessively plastic it becomes sticky and difficult to manipulate; with high shrinkage factor which will result in excessive cracking and warpage during drying and firing of the clay object[4]. Unfortunately, only very few natural clay satisfies the plasticity requirement of the studio potter, and that is why the issue of the proper adjustment and control of the physical property of the clay to make it workable has been a vital aspect of ceramic production.

However, it is noteworthy that ceramists have not been able to develop an efficient method of controlling the physical property of the clay. For instance, it is even difficult to determine which clay has the required plasticity even after certain adjustment has been made. According to Rhodes a clay or clay body can only be considered to be of the required plasticity after it had been used in production without difficulties[5]. In fact, “many attempts have been made to develop a method for measuring plasticity, but so many factors are involved, that no single method is entirely satisfactory”[6]. Ceramists “are in fact unable to measure plasticity, and have no units to apply to it”[7]. In particular, the simple methods for measuring plasticity usually adopted by the studio potter as recorded by Rhodes may give some indications of the plasticity of the material but they are by no means entirely satisfactory, and the results can be misleading[8].

Shrinkage is another characteristic of clay that can be counter-productive. Excessive plasticity results in high shrinkage, which in turn affects the product during drying and firing. This is the most obvious reason why the plasticity of the clay must be controlled. Shrinkage occurs during drying of the clay object and is always related to the grain structure of the clay and therefore, also to plasticity. Shrinkage is induced by plasticity and therefore any adjustment on the plasticity of the body is also intended to control the shrinkage of such body. Shrinkage brings about the reduction in size of the clay product after drying and firing caused by the evaporation of the water of fabrication and the chemically combined water in between the particles of clay, consequently the particles draw closer and closer together; thus taking up the space which had been occupied by the water [9]. With high plastic bodies, that is, bodies that are predominantly clay, this reaction can be very dangerous especially if the process is not gradual, because of the stresses set up which could lead to cracking and warpage Very often, these faults do not become apparent until after firing.

In recent times, the issue of how to control shrinkage has become of great concern to the ceramist. Even with the developments in technical ceramics the issue is still of paramount importance and has led to the introduction of new methods of ceramic production and the use of other materials of little or no plasticity which has been able to minimize some of the problems caused by shrinkage, However, in ceramic studios, where the facilities and resources for effective control of shrinkage are lacking, the usual trial and error in the addition of non-plastic materials to the clay has in most cases proved inefficient in controlling shrinkage. In Nigeria, for instance, and in most parts of the world, studio potters are still practicing the method. At least for the time being, the studio potters still make use of predominantly clay bodies with water as an essential ingredient for fabrication.

Plasticity as an important property in ceramic production is inevitable particularly for the studio potters who are specialized in the use of plastic bodies. In fact, plasticity enables clay-containing bodies to be shaped without cracking and breaking, and retain the shapes after production. And since water must be removed before the article can dry, shrinkage is inevitable. Therefore, it is impossible to eliminate shrinkage completely in a body that contains clay; in essence, what the potter tries to do is to minimize the negative effects of shrinkage on pottery products. On the other hand, since shrinkage is a natural phenomenon in such body, it implies that the occurrence of the associated faults is likewise inevitable especially for those who are unable to understand the physical behaviours of their clay bodies. Besides, a certain degree of shrinkage is needed for production when clay body is involved. For instance, a small drying shrinkage is desirable in pottery bodies to allow the formed article detached from the plaster mould, thus making its removal from the mold easier. If this were not the case, it would be impossible to produce clay objects from plaster mold.

In fact, to be precise, the potter contends with excessive shrinkage and, particularly uneven shrinkage, which results in a number of faults; warpage and cracking being the most frequent ones. The term “warpage” or “warping” is synonymous with distortion or loss of shape. Warpage refers to the loss of the original shape of the clay object during drying and firing. The object is caused to twist from the usual or natural shape of the object. In this case, the design is completely altered; while “cracking” refers to the partial separation of the wall of a clay product. Both warpage and cracking can render the piece useless especially where tableware or liquid storage container is involved. However, they can be allowed on ornamental piece, but where the crack is prominent and has weakened the piece or may lead to eventual separation, the piece is discarded.

The presence of shrinkage also means that the accuracy of dimension to which an article can be made is reducing, because where high accuracy or precision is required the moisture content of the body must be kept low, or water eliminated[10]. Actually, this is what the industrial ceramist has been able to achieve by lowering considerably the water content of its body or removing water completely and replacing it with organic binder such as gum arabic, glue, starch etc. These are added to the powdery clay; the articles being made, using advanced pottery equipment (Jollying and Jiggering, the Roller Machine, Isostatic Press, to mention but a few). Unfortunately, these equipment are not yet within the reach of most studio potters, particularly those practicing in a country like Nigeria, hence they are unable to produce wares of high accuracy in size. Therefore, the inability of the studio potter to produce wares of a given specification arises from the constraint imposed by this factor (shrinkage), which he could not control.

Apart from plasticity and shrinkage, clay as a medium for artistic expression also imposes certain limitations on form or design. Even though it is easy to handle and gives room to many creative possibilities yet clay has its own subtle ways of resisting careless handling. In fact, there seem to be too many forms or possibilities to choose from in this age of artistic experimentation. In the past the potter had only a limited number of forms available to him, and his expression was contrived in terms of these forms which are still prevalent in traditional pottery with its characteristic spherical, hemispherical and oval forms derived from the society’s environmental, mythical and religious attributes [11]. The real problems is not making forms but the ease with which they are made and their survival during and after production are certainly all that matter. It is therefore necessary to avoid making forms that are not possible with clay medium, otherwise, ceramic expression becomes more stressing and worthless venture. Consequently, because of the restrictions clay imposes on the production of certain forms, potters concentrate on forms within the stretched limits of clay.

Nevertheless, clay as an obedient servant responds to certain forms of shaping. It can be moulded, pounded, pinched, thrown, pressed, stamped, etc., which enables the potter to express his creative potentials within the possible limits allowed by the clay. For instance Rhodes notes that

> clay does not have the obdurate hardness of stone, the temperamental stringiness of wood, or the hard-to-join quality of metal, but it has a fragility and changeableness which require cuddling ... clay working does not tolerate carelessness, thus even the most primitive clay-working procedures have been directed by craftsmanship of a delicate sort, each pot has been nursed into existence with some care. Merely to handle a raw, dried pot properly and to get it into the kiln requires some tenderness towards it ... forms which are too attenuated are not suitable to clay and forms which are too extreme may collapse in the wet state before they can be finished[12].

Fraser has also noted that:

> it is important that wares should be of even section throughout-free of thick and thin areas. Curves should be gently rounded instead of acute, and sharp angles should be avoided … Holes cut or punched into the ware are weak spots. They should be rounded instead of angular … Fluting or grooves cut into the ware will weaken the structure as well as will the presence of any joints and attachments of stuck-on additions [13].

Thin-walled pots are difficult to produce especially the big types. Thinness produces a weak wall so that the pot IS unable to stand and will eventually collapse in the making process. Apart from producing weak wall there is also the problem of fast drying; the areas produced earlier gets over dried in relation to the newly produced areas which results in differential stresses built up on the wall of the pot causing it to warp, crack or even break apart. Besides, such pots, particularly at the bisque stage, are fragile and risky because of the danger of chipping at the rims or handles. So, no matter how skillful the potter is, it is virtually impossible for him to produce a very thin-walled pot like that 'of sheet metals and some plastic containers.

On the other hand, wares that are too extreme or too thick become excessively heavy and drying is hindered. Like the thin-walled pots, those that are too thick are also susceptible to collapsing during the making process because of excessive weight. At the modeling and drying stages, it may seem these are the only problems associated with thick pot, but during firing, the potter encounters a more serious problem. The danger of explosions resulting from steam forming in the ware is greatly increased by thick-walled pots.

Today, the studio potter is faced with the problem of determining the right thickness to be given to his pot; such that will not be prone to these faults. Even though some authors have suggested certain thicknesses, derived from the type of bodies they used, and since shrinkage vary from body to body such thicknesses may not be applicable to the type of bodies used by other potters, because clays from different locations rarely behave alike owing to different levels of contamination. While some are moderately plastic others are excessively plastic, etc. Even methods of production vary from potter to potter. While some specialize in modeling, others may be more interested in throwing and casting. The rates of drying or degree of shrinkage of wares produced through these methods vary also. Therefore, the potters are not guided by any laid dawn rules or principles to determine the thickness of their wares. That is why the thickness of the wares produced by studio potters varies from person to person. What the potters have been doing is the usual trial and error, which proves unsuccessful most of the times.

Pottery forms are not expected to have what the potters refer to as ‘weak points’ or ‘weak spots’. As reported by Fraser, ‘weak point’ is any sharp edge or protrusion from the wall of the pot, which has the tendency to chip off during handling or with slight knock, even after the pot has been gloss fired [14]. The more rounded the pots are, the better their walls can withstand knocks. During firing, rounded pots are more resistant to thermal shocks. “Sharp edges and corners imply high stress concentration, and should therefore, be avoided”[15]. Bowls and plates should have semicircular edges for better chipping resistance. Handles and spouts are better treated so that they do not become weak points. In most cases, weak points help to enhance the beauty of the pot but since they are likely to breakaway with time thereby ruining the pot, it is advisable to avoid them.

Forms that are tilted excessively will collapse during firing especially at high temperatures (fig. i). At a certain stage in the firing process (i.e during vitrification), the clay particles become loosely compacted weakening the form and if the form is inclined considerably it will bend, warp or collapse completely. In addition, potters avoid long appendages that lie horizontal or at 90 degrees to the surface of the pot because they are more prone to these faults (fig ii). In other to minimize these faults, potters favour those forms and long appendages that lie not less than 60 degrees to the horizontal (fig. iii).

In the same vein, forms whose bases occupy large surface areas than other parts are prone to warpage and cracking during drying and firing [16]. When the base of the pot is flat and too large in relation to its wall the shrinkage is usually with some difficulty. Cracking and warpage have more chances of developing when the ware shrinks with difficulty. This is why studio potters avoid the production of large tiles, plates and trays. The rim of these forms dry differently from their base centers and that is why they have few chances of survival.

Fig. i:

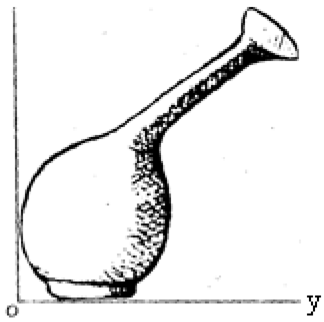


Fig. ii

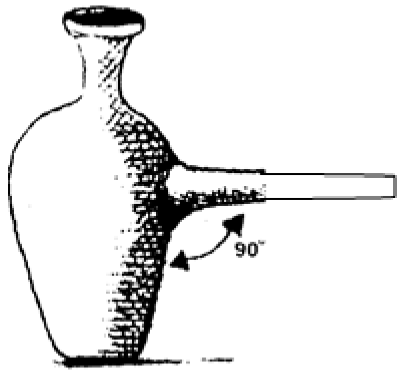
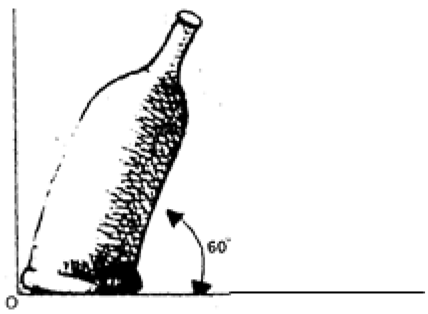


Fig. iii



Most pottery wares are designed to serve specific functions. Such wares have certain attributes that enable them to perform these functions, which mean that any attempt to deviate from this standard will render the ware useless. For instance, for a cup to be handled with ease when in use it should have a handle. Likewise, spout and handle are fitted to the water jug to enable it serve water effectively. A part from these appendages, the form proper should be such that will enhance the functionality of the ware. While a spherical form will serve as cup with difficulty, a short cylindrical form is already a cup even without a handle.

This is the area where there is a kind of disagreement among the potters; while some adhere strictly to these basic design principles, others mainly the new generation potters, believe that any form can be used provided it can serve the purpose for which it is made. These new generation potters hide under the cloak of creativity to neglect some of these design principles. There are those who, for instance, produce a cylindrical cup and affix animal form to it as handle. Nowadays, forms that look like shrine objects are being presented as tablewares. Even in decoration, hygienic aspect of ceramic production is no longer being taken seriously. How can one produce a tableware with a badly textured surface forgetting that such surface will hide dirt and may be difficult to wash. Even a layman knows that the eye will eat first before the mouth, which means that when the food appears tasty it encourages the appetite. Also, when a tableware has a dirty glazed surface as a result of discoloration people would not like to possess it because of the fear of food contamination. No wonder when some people look at some of these forms, they ask questions that suggest that they cannot be used to serve table except for decorative purposes.

The point is not that potters should not be creative, after all there is the sculptural aspect of the profession which offers the potter a wide range of creative vision, but it is important to note that when it comes to utilitarian wares, certain degree of caution is required so that those in generations to come will not lose track of these basic principles thereby hindering them from the potters primary function of contributing to the provision of the utilitarian needs of the society.

There is also the problem of producing large heavy works for outdoor use, for instance, in ceramic gardens and landscapes (see Karin 2000). Karin affirms that large clay works "are not only heavy but often bulky and complex in shape which makes them difficult to manoeuvre and they may not easily fit into the kiln"[17]. The idea of breaking the form into small manageable modules which can be assembled after firing to build a single large form can result to distortion if not carefully executed. It can be risky too, because if a module is broken the entire form is lost.

Limitations Arising from Firing

Firing is perhaps the operation least understood and least controlled in pottery production. The failures, accidents and frustrations being experienced in this process by the studio potter is better understood in the words of Rhodes.

> For potters, the firing process has always been a matter of intense concern, perhaps because of the uncertainties attending it. Placing one's pieces in the kiln is a kind of surrender, a giving up to the metamorphic forces of the fire. All ceramists feel a sense of excitement when the kiln is opened, but most also experience a feeling of letdown and depression after the pieces have been removed from the kiln and inspected. Firing is critical, and when it is successful the fruits of all the other processes are reaped. But by the same token, if it fails all else is canceled and accounts for nothing. Unfortunate accidents to the ware have brought considerable anxiety to the potter. The suspense of awaiting the final results of one's labours with the opening of the kiln is the central experience of the ceramist. To be a ceramists is not only to understand but to feel this transformation of the fire, and to be able to live with it, work with it, and to collaborate with it. .. only experience will enable the kiln watcher to cope with the unexpected [18].

Firing is an important aspect of the production processes because that is what gives value to the ceramic products. Clay objects can only be useful after they have been subjected to heat treatment. Firing renders pottery products hard, rocklike, and impervious to water. It is only at this state they can be valuable. If this were not the case, it would be useless to make objects from clay.

Unfortunately, firing is the most risky aspect of ceramic production because it can ruin the wares. Most of the reactions that take place in the kiln during the firing circle are not within the control of the potter, which is why a lot of uncertainty surrounds the process. Potters are yet unable to master and control the mysteries associated with firing. It is regrettable, however, that in spite of the effort put in careful management and control of the kiln during firing still a number of things go wrong.

The studio potter is perhaps the most badly affected as he is constrained to adopt firing method that is made possible by the equipment and resources available at his studio. Unlike the industrial potter the studio potter biscuits his ware at a very low temperature of about 800-900°C. At this temperature most of the reactions that affect the product have not been completed, thus when the ware is subsequently subjected to a gloss firing of a higher temperature of about 1100-1250°C these reactions continue in the gloss firing so that there is more chances of loss than there is with the method adopted by the industrial potter. Industrial potters adopt the reverse technique whereby the ware is biscuit at a higher temperature and gloss fired at a lower temperature.

The advantage this has over the studio potter's technique is that since the body will have been fired to its maturing point on the first firing, any fault, mainly cracking, warpage or distortion must have been completed at the biscuit stage. Those wares having faults must have been sorted out and do not form part of the gloss firing. The risk of loss arising from these faults is completely eliminated [19]. In fact, the only advantage the studio technique has is that the wares are of good porosity, which enables them to pick-up, a good film of glaze during the dipping operation mainly employed by the studio potter. But the industrial potter is able to overcome glazing problems associated with his non-porous bodies by using sophisticated equipment and materials.

In fact, the most common problems that arise from firing originate from the nature of clay. Further shrinkage occurs during firing, caused by the completion of drying and the re-arrangement of the clay particles. This is considered a very critical point in the firing process because at this stage the ware is prone to cracking and warpage At this point, there is also the danger of explosions resulting from steam built up in the ware particularly wares with thick walls or heavy cross sections.

"It must be borne in mind that many clays", particularly the secondary clays "are impure and these impurities have a marked effect on the products"[20]. Primary clays are the types widely favoured by the studio potters because they are common, easy to procure and inexpensive to prepare. The presence of iron oxide in the clay is of great concern to the ceramist. Iron is the material, which most affects the colour of glazes, and this is present in all secondary clays in amounts, which vary from 8 percent for red earthenware, to 2-3 percent for stoneware [21].

However, for the studio potter specializing in the production of clay sculptures, most of the effects of iron on glazes can be very interesting and such potter tends to accept iron in his clays. But in the production of table wares, where a high degree of purity or whiteness is required, iron oxides is regarded as a very troublesome impurity For instance, white coloured wares are difficult to produce with clays contaminated with iron. Iron oxide attacks the colour of glazes resulting in discolourations and specks, which sometimes appear dirty looking on the surface of the ware. Therefore, the inability of the studio potter to produce wares with clear coloured glazed surface is caused by the presence of iron oxide in his clay.

Finally, for the studio potter, what comes out of the kiln appear as strange objects, quite beyond his power to visualize or predict. Sometimes, the kiln confers graces on the object, which exceed even the potter's imaginations. In the production processes, the potter employs all he could to ensure success. still the fire is the final arbiter that determines what happens at the end.

Conclusion

This paper has shown the studio potter, unlike the sculptor contends with a lot of hindrances during the production processes some of which has been highlight Evidently, majority of these problems, which are purely technical, originate basically from the nature of the fundamental raw material-clay. Virtually all the physical behaviours of clay that are necessary for pottery making are also responsible for most of the faults found on the product. Unfortunately, the studio potter, particularly in Nigeria, is not in a position to control the faults owing to financial constraints precipitated by his level of pottery practice, and consequently these have continued to influence negatively the quality of designs and his creative potentials when compared with the sculptor.

References

1. Ryan, William *Properties of Ceramic Raw Materials*, England, Pergaman Press, 1978, p 13.

2. Ryan, *Properties of Ceramic Raw Mat*erials, p 21.

3. Rhodes, Daniel *Clay and Glazes for the Potter*, London: Pitman Publishing Limited, 1975, p 9; and Fraser Harry *Ceramic Faults and their Remedies*, London, A & C Black Publishers, 2005, p 19.

4. Rhodes *Clay and Glazes for the Potter*, p 14.

5. Rhodes *Clay and Glazes for the Potter*.

6. Worral W.E *Ceramic Raw Materials*, England, Pergamon Press, 1982, p 44.

7. Ryan *Properties of Ceramic Raw Materials*, p 21.

8. Rhodes *Clay and Glazes for the Potter*, p 66

9. Rhodes *Clay and Glazes for the Potter*, p.14 and Rado Paul *An Introduction to the Technology of Pottery*, England, Pergamon Press, 1988, p 84.

10. Ryan *Properties of Ceramic Raw Materials*, p 27.

11. Ali Vincent "Igbo Traditional Pottery: Types, Forms and Functions", *Uso: Nigerian Journal of Art*, 2001, Vol 3, No. 1 & 2, p 22.

12. Rhodes *Clay and Glazes for the Potter*, p xviii.

13. Fraser *Ceramics Faults and their Remedies*, p 84.

14. Fraser *Ceramics Faults and their Remedies*.

15. Rado *An Introduction to the Technology of Pottery*, p. 207.

16. Fraser *Ceramics Faults and their Remedies*.

17. Karin Hessenberg *Ceramics for Gardens and Landscapes*, London, A & C Black Publishers, 2000, p 140.

18. Rhodes Daniel *Kilns, Construction, Design and Operation*, London, Pitman Publishing Limited, 1977, p 197.

19. Fraser Harry *Electric Kilns and Firing*, London, Pitman Publishing, 1980, p 56-57.

20. Worral *Ceramic Raw Materials*, p 26.

21. Cooper Emmanuel *Electric Kiln Pottery*: *The complete Guide*, London: B.T. Batsford Limited, 1982, p 41.

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